Frequency Meter SM 209

Instruction Manual

SM209

MP MASTER
MA24012

Instruction Manual

FREQUENCY METER

Series

SM 209

ISSUE1

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ADDENDUM TO SECTION 3

Equivalent Connection Points of Preset Card Pins on Socket J1 (Main Logic Board A3)

A3 J1	Preset Board Pins
A	1
1	2
B	3
2	4
C	5
3	6
D	7
4	8
E	9
5	10
F	11
6	12
G	13
7	14

A3 J1	Preset Card Pins
H	15
8	16
I	17
9	18
J	19
10	20
K	21
11	22
L	23
12	24
M	25
13	26
N	27
14	28
O	29
15	30

LIST OF AMENDMENTS

Al.No.	By Whom	Date	Al.No.	By Whom.	Date.

PREFACE

DAMAGE IN TRANSIT

Unpack the equipment and examine it thoroughly to ascertain whether any damage has occurred in transit. Report immediately any such damage to the agent or manufacturer. Retain the four rubberized packing surrounds, should a return to manufacturer be necessary.

GUARANTEE

2. All goods manufactured by the Company are guaranteed to the extent hereafter mentioned against defects arising from faulty material or workmanship subject to the goods not having suffered maltreatment or interference. The Company's liability under this guarantee is limited to replacing any part or parts found defective within a period as laid down in Company instructions after the date of delivery or installation.

If goods not of the Company's manufacture are ordered, the guarantee of that company is to be accepted.

LOCAL AGENTS ADDRESS:-

The address of your local agent is:-

DESCRIPTIVE MATTER AND ILLUSTRATIONS.

Descriptive matter, illustrations, dimensions and weights issued by the Company are typical and shall not be held as binding. The Company reserves the right to alter patterns and designs without notice.

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SECTION 1

SPECIFICATIONS

1. FREQUENCY METER SM209

1.1 Modes of Operation

(a)	Frequency	Range:	Channel A: 10 Hz to 220 MHz Channel B: 5 MHz to 512 MHz
		Input:	Channel A or Channel B
		Resolution:	10 Hz or 1 Hz. The number of digits displayed may be selected as 5,6,7, 8 or 9
		Accuracy:	± 1 count ± time-base accuracy
		Readout:	Divided into three 3-digit groups labelled MHz, kHz and Hz.
(b)	Frequency Ratio	Frequency Range:	Channel A: 10 Hz to 220 MHz Channel B: 5 MHz to 512 MHz Channel C: 1 kHz to 1.2 MHz
		Input F1:	Front Panel Channel A or Channel B.
		Input F2:	Rear Panel Channel C (external clock input)
		Measures:	$F1/F2 \times 10^5$ with the 1 sec Time-base push-button released and $F1/F2 \times 10^6$ when depressed.
		Accuracy:	± 1 count of F1 ± $\frac{\text{trigger error of F2}}{10^5 \text{ or } 10^6}$
		Readout:	Dimensionless

1.2 Input Channels A, B and C

(a)	Channel A	Impedance:	1 Megohm shunted by 25 pF approx.
		Input Coupling:	AC
		Frequency Range:	10 Hz to 220 MHz
		Sensitivity:	50 mV r.m.s. 10 Hz to 120 MHz, decreasing to 100 mV r.m.s. at 220 MHz
		Attenuator:	Continuously variable vernier control
		Maximum Input:	600 V d.c. 250 V r.m.s. 10 Hz to 10 kHz 10 V r.m.s. above 10 MHz

(b)	Channel B	Impedance:	50 ohm nominal
		Input Coupling:	AC
		Frequency Range:	5 MHz to 512 MHz
		Sensitivity:	Better than 10 mV r.m.s.
		Attenuator:	Internal automatic gain control circuit (AGC) controls the amplitude of the signals supplied to the input amplifier.
		Maximum Input:	50 V d.c., 5|V|r.m.s. a.c.
(c)	Channel C	(External Time Base Input on rear panel)	
		Impedance:	1 kohm
		Input Coupling:	AC
		Frequency Range:	1 kHz to 1.2 MHz
		Sensitivity:	0.25 V r.m.s.
		Maximum Input:	50 V d.c. 10 V r.m.s. a.c.
1.3	Display	Numerical:	9 long-life display tubes.
		Units:	MHz, kHz and Hz
		Display Storage:	Prior reading is held while new reading is being taken. Display time is adjustable from 0.2 to 5 seconds or can be held indefinitely.
		Gate:	Illuminated when counter gate is open.
		Manual Reset:	Front-panel push-button switch resets the display and all registers, and initiates a new measurement.
1.4	Timebase	Crystal Frequency:	10 MHz
		Aging rate:	Less than 2 parts in 10^9 per day
		Long Term Stability:	Less than 4 parts in 10^7 per annum
		Temperature Stability:	Less than 1 part in 10^9 per °C
		Warm-up time:	4 minutes up to 1 part in 10^7
1.5	Printer Output	Logic:	Positive true
		Form:	4-line 1-2-4-8 BCD "1" state level: + 5 ± 0.5 V 2.5 kohm source impedance nominal. "0" state level: + 0.25 V at – 1 mA
		Print Command:	Positive pulse of 5 V d.c. coupled. Source impedance is 1 kohm when in the "high" state and 100 ohm when in the "low" state. Pulse duration is 1 ms approx. Occurs at end of gate time.

MANUAL CHANGE AL 1
for
TIMER/COUNTER MANUALS

~~SM 202~~, ~~SM 205~~, SM 209.

REASON FOR CHANGE

Change in stated specification of daily ageing rate and long term stability figures for crystals as follows:

~~SM 202~~, SM 209.

Amend specification figures to read:

Daily Ageing Rate: <3 parts in 10^9 per day (average over 10 days)

Long Term Stability: <1 part in 10^6 per annum.

SM 205

Amend specification figures to read:

Daily Ageing Rate: <6 parts in 10^8 per day (average over 10 days)

		Inhibit Input:	A positive pulse of 3 V minimum and 50 V maximum will inhibit the recycling circuitry of the counter.
		Connector:	Amphenol 57-40500-375 (50-pin blue ribbon) Mating connector Amphenol 57-30500-375
1.6	**Power Requirements**	Voltage:	115 V ± 10% or 230 V ± 10%
		Frequency:	48 Hz to 400 Hz
		Consumption:	30 W
1.7	**Dimensions**	Height:	3½ in (88 mm)
		Width:	$8\frac{3}{8}$ in (212 mm)
		Depth:	12½ in (317 mm)
		Weight:	7 lb (3.2 kg)

2. FREQUENCY METER SM209F

2.1 Specification as for SM 209, but fitted with a preset card providing automatic subtraction of (specified) i.f. frequency. Additional cards are available.

SECTION 2

GENERAL INFORMATION

1. INTRODUCTION

1.1 The Frequency Meter Model SM 209 (Fig. 2.1) is a compact instrument providing precise frequency measurements from 10 Hz to 512 MHz. It incorporates simple controls and a readily accessible layout for easy operation and maintenance. For ease of readout, the 9 digit display is divided into three 3-digit groups, labelled MHz, kHz and Hz. Push-button switches on the front panel allow for selection of 5,6,7, 8 or 9 digits of resolution.

2. MODES OF OPERATION

2.1 The frequency meter has two modes of operation:

(a) **Frequency Mode.** In this mode, the signal to be measured is connected to the A Channel input (range 10 Hz to 220 MHz) or the B Channel input (range 5 MHz to 512 MHz) and the display indicates the frequency of the input signal.

(b) **Frequency Ratio Mode.** In this mode, the ratio between two input signals is measured. The signal with the higher frequency is connected to the A or B input channel and the signal with the lower frequency is connected to the external clock input on the rear panel. The display indicates a non-dimensional ratio of $\frac{F1}{F2} \times 10^5$ with the R.H. display blanking push-button selected, or $\frac{F1}{F2} \times 10^6$ with the 1-sec push-button selected.

3. PRINTER OUTPUT FACILITY

3.1 A 50-way output connector is fitted as standard to the rear panel of the instrument to provide 9 decades of BCD output, a Print Command output and a recycle inhibit input. Connections for these are listed in *Section 3, Para. 6.2*

4. PRESET FACILITY (SM 209F, SM209FC)

4.1 Frequency Meter SM 209F has the capability of accepting a preset plug-in card, so that the instrument can be used to measure the tuned frequency of a communication receiver.

4.2 Frequency Meter SM 209FC has the capability of Model SM 209F, but is fitted with a card, preset (at the factory) to the exact value of intermediate frequency associated with a particular communication receiver. Additional preset cards can also be supplied.

FIG. 2.1 FREQUENCY METER SM 209

4.3 The tuned frequency of the receiver is selected, filtered and amplified by the receiver. The relation between the receiver's local oscillator frequency (F_{lo}), the intermediate frequency (F_{if}) and the tuned input frequency ($F_{i/p}$) is:

$$F_{i/p} = F_{lo} - F_{if}$$

4.4 The preset circuit in the SM 209FC automatically subtracts the intermediate frequency while measuring the local oscillator frequency. The number representing the intermediate frequency is wired-in on the p.c. card (this can be changed by the user as detailed in ***Section 3, Para. 6.3***). The frequency meter then measures the receiver's local oscillator frequency to give a direct readout of the received input frequency.

5. POWER REQUIREMENTS

5.1 The instrument is capable of operating from a power source in the ranges 115 V, ± 10% or 230 V, ± 10% at frequencies between 48 Hz to 400 Hz. The power consumption is approximately 30 W. The method of altering the instrument to suit the local power source is given in ***Section 3, Installation***.

6. RACK MOUNTING

6.1 The physical dimensions are such that the instrument can be used on the bench or rack mounted in a standard 19 inch (width) rack. The chassis is drilled to accept a rack mounting kit which is supplied as an optional extra ***(See Section 3, Installation).***

SECTION 3

INSTALLATION

1. INTRODUCTION

1.1 This section contains all information necessary to install the instrument. The SM 209 is despatched in an operational condition, and should be checked for damage immediately upon receipt.

2. EQUIPMENT LIST

2.1 The instrument is supplied with the following items:-

(a) 6 foot mains input lead with connector - 1 off

(b) Instruction Manual - 1 off

(c) Rack Mounting kit SM 209/R (optional extra).

3. RACK MOUNTING

3.1 The SM 209 can be rack mounted in various ways as follows:

(a) **Mounting 1 instrument in Centre of Rack.** On fig. 3.1. drawing No. E 33647 shows the method and parts employed. The part numbers of the rack mounting items are listed below:

Item	Part	S.E.L. Part No.	Qty.
1	Special Nut	D 33936	4
2	Bracket	D 33937	2
4	Panel	D 33939	2
8	Screw, CH. HD, M3 x 12LG	—	4
9	Screw, Pan HD, M6 x 12LG	—	4
11	Washer, crinkle, M3	—	4
12	Washer, crinkle, M6	—	4
13	Washer, Plain, M6	—	4
14	Nut, M6	—	4

(i) Remove top and bottom covers. Fit the brackets (item 2) to the sides of the instrument using the special nuts (item 1), screws (item 8) and washers (item 11) supplied.

(ii) Fit the two side panels (item 4) to the brackets (item 2) using the screws (item 9), washers (items 12 and 13) and nuts (item 14).

(iii) Cut out both front corners of the top and bottom covers. The angle and measurement are shown in the inset on fig. 3.1. Fit the modified covers to the instrument.

(b) **Mounting 1 instrument to the Left (or Right) of the Rack.** On fig. 3.1., drawing No. E 33643 shows the method and parts employed. The part numbers of the rack mounting items are listed below.

Item	Part	S.E.L. No.	Qty.
1	Special Nut	D 33936	4
2	Bracket	D 33937	2
3	Panel	D 33938	1
8	Screw, CH. HD. M3 x 12 LG	—	4
9	Screw, Pan HD, M6 x 12 LG	—	2
11	Washer, Crinkle, M3	—	4
12	Washer, Crinkle, M6	—	2
13	Washer, Plain, M6	—	4
14	Nut, M6	—	2

(i) Remove the top and bottom covers. Fit the brackets (item 2) to the sides of the instrument, using the special nuts (item 1) screws (item 8) and washers (item 11), supplied.

(ii) Fit the panel (item 3) to one of brackets (item 2), depending upon which side of the rack the instrument is to be mounted. Using the screws (item 9) washers (item 12 and 13) and nuts (item 14) supplied.

(iii) Cut out both front corners of the top and bottom covers to the measurements shown in the inset in fig. 3.1. Fit the modified covers to the instrument.

(c) **Mounting 2 Instruments in a Rack.** On fig. 3.1, drawing No. E 33648 shows the method and parts employed. The part numbers of the rack mounting items are listed below.

Item	Part	S.E.L. No.	Qty.
1	Special Nut	D 33936	12
2	Bracket	D 33937	2
5	Spacer	D 33940	2
7	Special Screw	D 33942	4
9	Screw, CH HD, M3 x 12 LG	—	8
11	Washer, Crinkle, M3	—	12

(i) Remove the top and bottom covers of both instruments. Fit the instruments together at the front and back using the spacers (item 5), special nuts (item 1), special screws (item 7).

NOTE: The tapped hole in each of 4 of the special nuts (item 1), should be drilled to 3.3 mm diameter clear before fitting. This is required so as to clear the special screws (item 7).

(ii) Fit the brackets (item 2) to a side of each instrument using the screws (item 9), washers (item 11) and special nuts (item 1).

(iii) Cut out 3 corners on the top and bottom covers of each instrument (two front corners and one inside rear corner) to measurements shown in the inset on fig. 3.1. Fit the modified covers to each instrument.

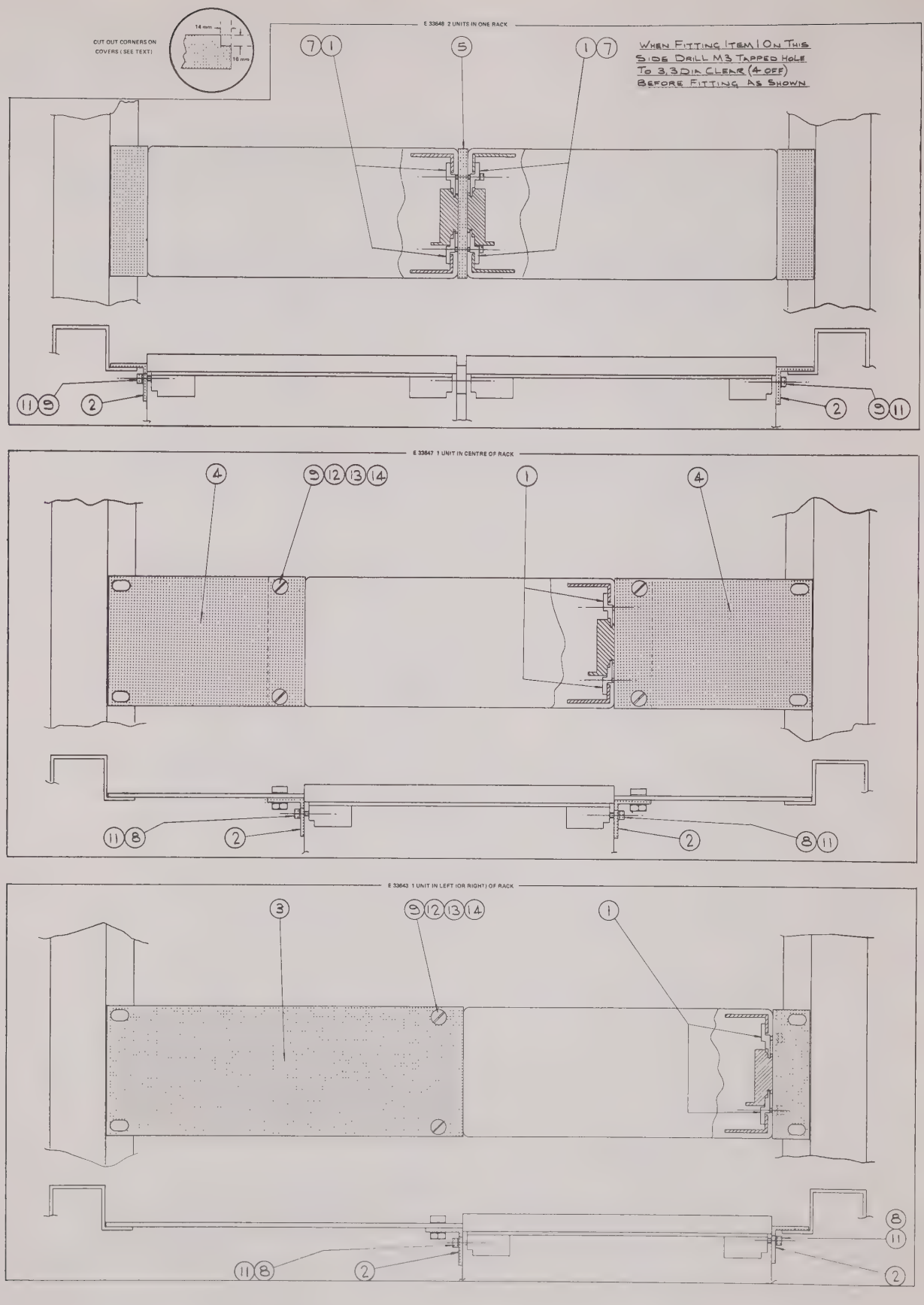

CUT OUT CORNERS ON COVERS (SEE TEXT)
14 mm
16 mm
E 33648 2 UNITS IN ONE RACK
WHEN FITTING ITEM 1 ON THIS SIDE DRILL M3 TAPPED HOLE TO 3.3 DIA CLEAR (4 OFF) BEFORE FITTING AS SHOWN
E 33647 1 UNIT IN CENTRE OF RACK
E 33643 1 UNIT IN LEFT (OR RIGHT) OF RACK

FIG. 3.1 RACK MOUNTING ARRANGEMENTS

4. PRECAUTIONS

4.1 **Grounding.** The instrument is provided with a 3-wire power lead, which grounds the case when connected to a 3-pin mains socket. If a grounding outlet is not available, an adaptor must be used which provides a good grounding connection.

4.2 **Cooling.** Cooling air enters the case through holes in the covers. Adequate clearance must be provided on all sides of the instrument to allow heat to be dissipated. Make sure that the position of the instrument allows adequate air circulation and that nearby equipment does not discharge hot air directly on the instrument.

5. OPERATING POWER SOURCE.

5.1 Ensure that the instrument is correctly set to operate from the local power source. To alter the primary voltage setting insert a small screwdriver into the LINE SELECTOR slide switch on the rear panel and set the switch to the required value.

6. CONNECTIONS

6.1 **Mains Input Socket.**

Pin	Wire Colour Code
Live	Black
Neutral	White
Earth	Green

6.2 **PRINTER Connector.** (Amphenol 57-30500-375). The pin connections and functions for the 50-way printer connector are listed below.

(a) BCD Outputs

DECADE BCD Code	1 Pin No	2 Pin No	3 Pin No	4 Pin No	5 Pin No	6 Pin No	7 Pin No	8 Pin No	9 Pin No
1	1	3	5	7	9	11	13	15	17
2	2	4	6	8	10	12	14	16	18
4	26	28	30	32	34	36	38	40	42
8	27	29	31	33	35	37	39	41	43

Logic Levels: Logic 1, +5V, ± 0.5V (2.5 kΩ Source Impedance nominal)

Logic 0, +0.25V at −1mA

(b) Other Functions

Pin No	Function	Operative Levels
22	Inhibit Input	Logic 1 (+3V to +50V)
23	Positive Print Command	Logic 1 (+5V, 2ms duration pulse)
50	Ground	

NOTE: Pins 19,20,21,24,25,44 to 49 (incl) not used.

6.3 Preset Card Connection Points

Preset cards for any i.f. frequency can be supplied from the factory. However, blank cards can be provided and the wiring added by the user.

The preset card has 28 connecting points (marked 1 to 28) which must be connected either to the +5 V supply (logic 1) or to ground (logic 0). To select a logic 1, a wire must be inserted in the hole opposite the number, on the Vcc rail, and soldered on both sides of the card. To select a logic 0, the wire must be connected to ground. The connections to be made for the required preset value are given in the Table below. Note, that the first two least significant digits cannot be preset.

Preset to	Decade 3 Connect 26 27 25 28	Decade 4 Connect 22 23 24 24	Decade 5 Connect 18 19 17 20	Decade 6 Connect 14 15 13 16	Decade 7 Connect 10 11 9 12	Decade 8 Connect 6 7 5 8	Decade 9* Connect 2 3 1 4
0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
1	1 0 0 0	1 0 0 0	1 0 0 0	1 0 0 0	1 0 0 0	1 0 0 0	1 0 0 0
2	0 1 0 0	0 1 0 0	0 1 0 0	0 1 0 0	0 1 0 0	0 1 0 0	0 1 0 0
3	1 1 0 0	1 1 0 0	1 1 0 0	1 1 0 0	1 1 0 0	1 1 0 0	1 1 0 0
4	0 0 1 0	0 0 1 0	0 0 1 0	0 0 1 0	0 0 1 0	0 0 1 0	0 0 1 0
5	1 0 1 0	1 0 1 0	1 0 1 0	1 0 1 0	1 0 1 0	1 0 1 0	1 0 1 0
6	0 1 1 0	0 1 1 0	0 1 1 0	0 1 1 0	0 1 1 0	0 1 1 0	0 1 1 0
7	1 1 1 0	1 1 1 0	1 1 1 0	1 1 1 0	1 1 1 0	1 1 1 0	1 1 1 0
8	0 0 0 1	0 0 0 1	0 0 0 1	0 0 0 1	0 0 0 1	0 0 0 1	0 0 0 1
9	1 0 0 1	1 0 0 1	1 0 0 1	1 0 0 1	1 0 0 1	1 0 0 1	1 0 0 1

*Decade 9 is the most significant digit.

PRESET CARD INTERCONNECTION

SECTION 4

OPERATING INSTRUCTIONS

1. INTRODUCTION

1.1 This section familiarises the user with the typical operating procedures of the Frequency Meter SM 209. The front and rear panel controls, connectors and indicators are described. Recommended operating procedures demonstrate instrument flexibility.

2. SUMMARY OF CONTROLS, CONNECTORS AND INDICATORS

2.1 Figure 4.1 shows the instrument's front and rear panels. The controls are identified as follows:

(a)	DISPLAY TIME Control	A switch/potentiometer control that applies a.c. power to the instrument, and controls the display time.
(b)	RESET Switch	Resets display and internal count to zero and starts a new measurement.
(c)	GATE Indicator	A light-emitting diode that lights up when the instrument is counting.
(d)	TIME BASE/1 SEC Push-button	Selects the maximum resolution of the instrument.
(e)	DISPLAY BLANKING Push-buttons	Select 5,6,7 or 8 digit resolution.
(f)	INPUT A-B Selector	A two-position slide switch that selects either INPUT A or INPUT B.
(g)	INPUT 5-512 MHz Connector	A BNC connector which accepts signals over a frequency range of 5 MHz to 512 MHz.
(h)	INPUT 10 Hz - 220 MHz Connector	A BNC connector which accepts signals over a frequency range from 10 Hz to 220 MHz.
(j)	SENSITIVITY Control	A potentiometer control that varies the degree of input attenuation, thereby determining the minimum signal amplitude required to reliably trigger the instrument.
(k)	Display	A 9 digit numeric readout.
(m)	LINE SELECTOR Switch	Selects the nominal line voltage to operate the instrument.
(n)	Fuse 0.3T	Protects primary power circuit from accidental overload.

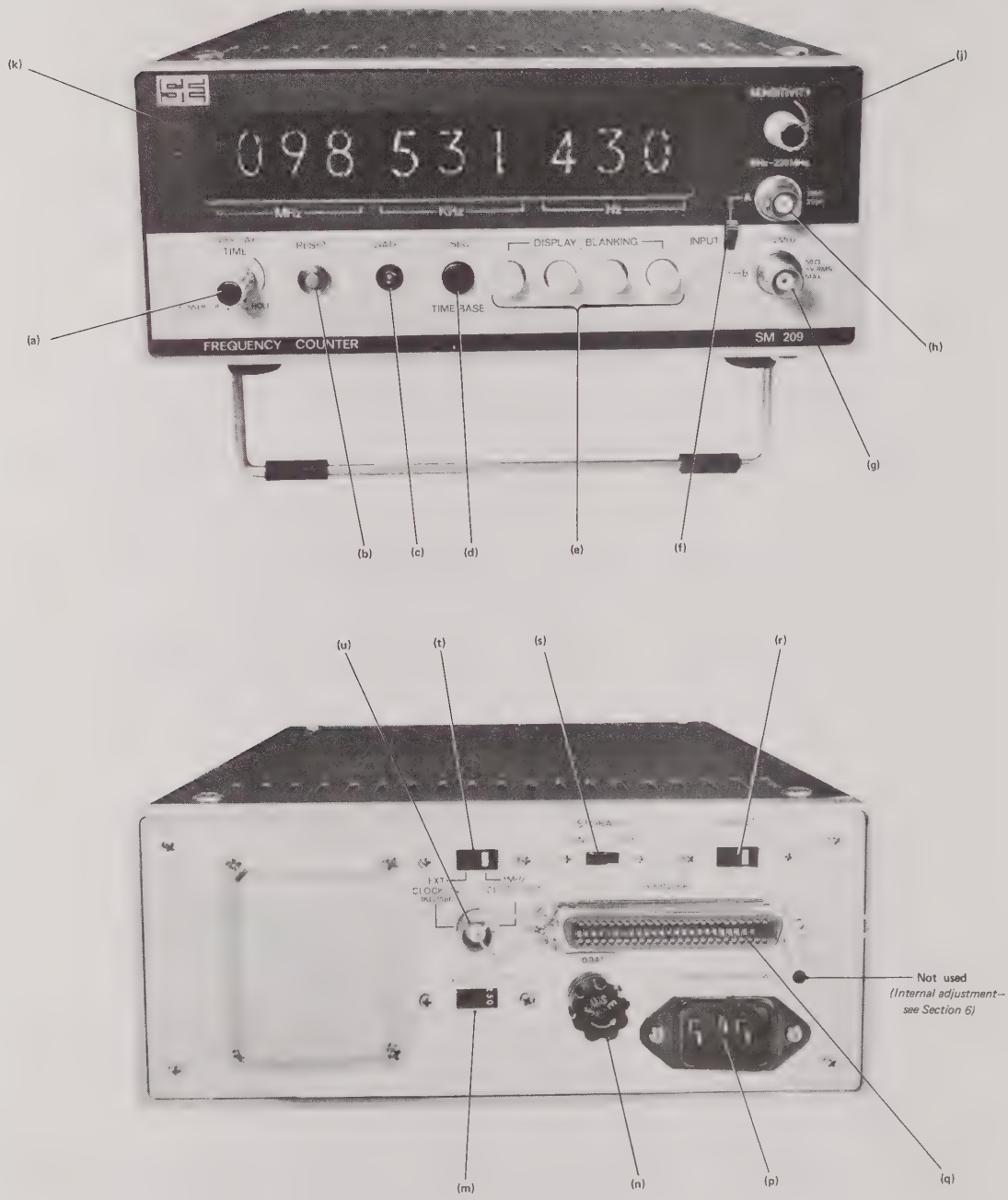


FIG. 4.1 CONTROLS, CONNECTORS AND INDICATORS

(p)	AC Power Connector	IEC type with offset pin connected to instrument chassis.
(q)	PRINTER Connector	A 50-pin connector for digital printer connection.
(r)	PRESET ON-OFF Switch	A recessed two-position slide switch used to enable or disable the preset feature (SM 209F, SM 209FC).
(s)	STORAGE ON-OFF Switch	A two-position slide switch. When set to ON, provides display storage while new measurement is being made. In OFF position, allows continuous display.
(t)	INT-EXT Clock Switch	A recessed two-position slide switch that permits selection of either the internal clock or an external clock. When set to internal, the 1 MHz clock is available via the associated BNC connector.
(u)	Clock In-Out Connector	A BNC connector that enables either the application of an external clock to the instrument or provision of the internal clock from the instrument. In the Frequency Ratio mode, this socket is used to accept the signal with the lower frequency.

3. OPERATING PROCEDURES

3.1 SENSITIVITY Control Adjustment.

3.1.1 The SENSITIVITY control permits adjustment of the input signal of Channel A to the optimum value for reliable triggering. It is not sufficient to set the control for maximum sensitivity, since the instrument may then be triggered by noise. Conversely, if the trigger level is too low, the instrument could be triggered at random or not at all. The optimum level is indicated by repeatability of the display. The correct procedure for setting the SENSITIVITY control is as follows:

(a) Set the INPUT A/B selector to A.

(b) Connect the signal to the front panel BNC connector.

(c) Set the SENSITIVITY control for minimum sensitivity (fully anti-clockwise). The instrument, in general, will not count in this position.

(d) Rotate the SENSITIVITY control clockwise until the instrument begins to count. Check for repeatability of the display and, if necessary, continue to rotate the control clockwise until repeatability is obtained.

3.2 Frequency Mode

(a) Connect the signal to be measured to the front panel input connector A or B. The Channel A frequency range is 10 Hz to 220 MHz and the Channel B range is 5 MHz to 512 MHz.

(b) Set the INPUT A/B slide switch to the channel selected.

(c) If Channel A is operative, adjust the SENSITIVITY control as outlined in Para. 3.1. The Channel B input has a built-in automatic gain control (a.g.c.) circuit and needs no adjustment.

(d) Select the required number of digits to be displayed by pressing one of the DISPLAY BLANKING pushbuttons. If a full 9-digit resolution is required, press the 1 SEC TIME BASE pushbutton.

(e) Set DISPLAY TIME control for a convenient display rate. The GATE indicator flashes on and off, at a rate determined by the DISPLAY TIME control setting. The instrument counts when the indicator is lit.

(f) The display indicates the frequency of the input signal.

3.3 Frequency Ratio Mode

(a) Connect the higher frequency input (F1) to the front panel input connector A or B. The Channel A frequency range is 10 Hz to 220 MHz and the Channel B range is 5 MHz to 512 MHz.

(b) Connect the lower frequency input (F2) to the rear panel EXT CLOCK IN connector.

(c) Set the INT-EXT CLOCK switch to EXT CLOCK IN.

(d) Set the INPUT A/B slide switch to the channel selected.

(e) If Channel A is operative, adjust the SENSITIVITY control as outlined in para. 3.1. The Channel B input has a built-in automatic gain control (a.g.c.) circuit and needs no adjustment.

(f) Set DISPLAY TIME control for a convenient display rate. The GATE indicator flashes on and off at a rate determined by DISPLAY TIME control setting. The instrument counts when indicator is lit.

(g) The display indicates non-dimensional ratio of $F1/F2x10^5$ with the R.H. DISPLAY BLANKING pushbutton depressed and $F1/F2x10^6$ with the 1 SEC pushbutton depressed.

3.4 Clock Selection

3.4.1 An internal 10 MHz clock is provided. There is also provision for using an external clock for increased stability or to obtain a special time-base. The clock selection is made by positioning the rear panel, two-position, recessed slide switch EXT CLOCK IN – 1 MHz CLOCK OUT to 1 MHz CLOCK OUT when using the internally provided clock, and to EXT CLOCK IN when using an external clock.

3.5 Preset Selection (SM 209F only)

3.5.1 The SM 209 has a built-in circuit for adding or subtracting intermediate frequencies (i.f.) while measuring the local oscillator frequency of a communication receiver.

3.5.2 Before a frequency measurement is made, the counting circuits of the instrument are preset to a number which is the difference between the maximum display capability of the instrument and the i.f. frequency. The 9 digit display has a display capability of 10^9 counts. If, for example, the i.f. frequency to be subtracted is 21.4 MHz, the preset should be at

$$\begin{array}{r} 1000000000 \\ 21400000 \\ \hline 978600000 \end{array}$$

3.5.3 Upon the opening of the main gate, the counting starts not from zero, but from the preset number. After exactly 21,400,000 pulses, the counter overflows and all digits go to zero. The counting process continues, and when the counter's main gate is closed, the count displayed is the oscillator frequency less the i.f. frequency.

3.5.4 If the i.f. frequency is to be added, the preset is to be set to the number to be added. The method of connecting the preset card to give the required number is given in *Section 3, Para. 6.3*

3.5.5 The internal preset circuitry is enabled or disabled by the PRESET ON-OFF switch on the rear panel. To enable the preset facility, set the PRESET switch to ON. To disable it, set the PRESET switch to OFF.

SECTION 5

CIRCUIT DESCRIPTIONS

1. INTRODUCTION

1.1 This section of the manual contains a description of the circuitry used in Model SM 209 and Model SM 209F. Figure 1 is a detailed block diagram of the instrument. Basically, the diagram can be broken down into six functional areas. These are:

(a) Channel A input circuit

(b) Channel B input circuit

(c) Time-base circuit

(d) The control circuit

(e) Counting circuits

(f) Power supply

Complete schematics are given in Section 7. Refer to these diagrams while reading the text.

2. ASSEMBLY DESIGNATIONS

2.1 The Table below lists the designations of the assemblies used in this instrument.

Assembly	Name
A1	Front Panel Assy
A2	Rear Panel Assy
A3	Main P.C. Board Assy
A4	"A" and "B" Input Circuit Assy
A6	Preset Card Assy

3. CHANNEL A INPUT CIRCUIT

3.1 The input signal, 10 Hz to 220 MHz, is routed via connector A1J1, coupling capacitor A1C1 to the SENSITIVITY control A1R1. This control varies the amount of attenuation. A4CR1 and A4CR2 form a bipolar limiter that protects the FET A4Q1 from overload. Transistors A4Q1 and A4Q2 are connected as a source follower and drive the differential amplifier A4Q3 and A4Q4.

3.2 Transistor pairs A4Q5, A4Q7 and A4Q6, A4Q8 are negative feedback amplifiers whose gain is determined by A4R17 and A4R18, and frequency response by the parallel-series RC combinations A4R17, A4R10, A4R27, A4C15 and A4R18, A4C11, A4R22, A4C14. The collectors of A4Q5 and A4Q6 are connected to the differential current amplifier A4Q9 and A4Q10. The current through A4Q10 operates the tunnel-diode A4CR4 acting as a waveform shaper. The sharp edges of the shaped input signal are differentiated by the RL differentiator A4R31 and A4L6 and amplified by A4Q11 and A4Q25.

4. CHANNEL B INPUT CIRCUIT

4.1 The input signal, 5 MHz to 512 MHz, is routed via connector A1J2, to the input circuit. The pin-diodes A4CR8 and A4CR9 act as current controlled resistors and are used to attenuate input signals exceeding the level determined by the automatic gain control (a.g.c.) circuitry.

4.2 Transistor A4Q15 forms a voltage-to-current converter and drives the shunt-feedback amplifier A4Q16 and A4Q26. The amplifier offers a low impedance to the collector of A4Q15 and a low impedance to the base of A4Q17. Transistor A4Q26 is connected in a common-base configuration and offers a low impedance to the collector of A4Q16 and also produces a greater degree of isolation between the open-loop input and output terminals of the stage. The second stage formed by transistors A4Q17, A4Q18 and A4Q19 is identical to the first one.

4.3 The last amplifying stage is formed by the current amplifier comprising A4Q20, A4Q21 and A4Q22. This amplifier drives the tunnel-diode shaper A4CR12. The shaped input signal is applied via emitter-follower A4Q23 to the input of the integrated circuit high-speed flip-flop A4U1. The complementary outputs of A4U1 are applied via emitter-followers A4Q24 and A4Q30 to the differential current amplifier A4Q28 and A4Q29.

4.4 The AGC circuit comprises integrated circuit d.c. amplifier A4U2, transistors A4Q12, A4Q13, A4Q14 and associated circuitry. The amplified input signal is rectified by A4CR7, smoothed by A4R37 and A4C24 and amplified by A4U2. The required amplitude, above which the AGC circuit starts to operate, is set by A4R40. The current supplied by A4Q14 is supplied to the current controlled resistors A4CR8 and A4CR9 which in turn control the amplitude applied to the input amplifiers.

5. 10 MHz CLOCK OSCILLATOR

5.1 The high-stability 10 MHz clock oscillator is a packaged unit and is adjusted to the exact frequency by a trimmer on top of it.

5.2 The oscillator output is fed to the decade divider A3U1.

6. EXT. CLOCK IN/1 MHz CLOCK OUT OPERATION

6.1 Connector A2J1 is used as an input point for an external clock and also for the output of a 1 MHz signal from the instrument. With switch A2S1 set to 1 MHz CLOCK OUT, Nand gate A3U4B is enabled and the 1 MHz clock output from A3U1 is applied to the timebase dividers. The 1 MHz clock output is also applied to A2J1 via resistor A2R146. When the switch A2S1 is set to EXT CLOCK IN, Nand gate A3U4D is enabled and the output of the Schmitt trigger A3U3 is routed to the timebase dividers. When externally triggered, the input to A3U3 is protected against overload by a pair of diodes A3CR1 and A3CR2.

7. CONTROL LOGIC

7.1 The control logic determines the start and stop functions for the count being taken, controls the routing of input and timebase signals, and the sequence of operation.

7.2 The timebase outputs from A3U12 or A3U13 are selected by the Nand gate selector A3U14. The selected output is applied to the input of the gate-control flip-flop A3U15A. After two consecutive clock pulses, flip-flop A3U15B is operated and its $\overline{Q}$ output goes low, thus inhibiting the input to A3U15A. This condition remains until a reset pulse is applied and the $\overline{Q}$ output of A3U15B goes high. While the gate signal from the $\overline{Q}$ output of A3U15A is low, shaped pulses from the input circuit are counted by the counting circuits.

8. SAMPLE RATE AND RESET CIRCUIT

8.1 In order to ensure sufficient time for a visual readout of the measurement, a DISPLAY TIME control is provided on the front panel. This control provides a reset pulse for a selected time interval (0.2 seconds to 5 seconds) after completion of a measurement. When the control is set to HOLD, the display is held indefinitely until the manual RESET pushbutton is depressed.

8.2 During the count interval, transistor A3Q5 is in saturation due to the high level on its base from the main gate control circuit. At the end of the count interval, A3Q5 is cut-off and causes capacitor A3C11 to start to charge. When the voltage across the capacitor reaches the unijunction transistor A3Q6 firing voltage, a negative-going pulse is produced and applied to the 'reset multivibrator' A3U7C and A3Q3. The output from A3Q3 resets the circuits in the instrument. A reset pulse can also be produced manually by operation of the RESET pushbutton. Setting the DISPLAY TIME control to HOLD disconnects the +15 V supply from the DISPLAY TIME control. Under this condition, A3C11 is not charged and therefore no reset pulse is generated.

8.3 The inhibit input is normally intended for use with an external digital printer, but it can also be used independently to provide an external form of display control. A high level at A2J2-22 saturates transistor A3Q7 and thereby inhibits the generation of a reset pulse.

9. GATE INDICATOR, TRANSFER AND PRINT COMMAND CIRCUITS

9.1 The GATE indicator light is operated from the output of the gate-control flip-flop A3U15A. When its output is low, the current through the light emitting diode (LED) A3DS10 causes the diode to light-up and to extinguish when high.

9.2 The transfer circuit generates a positive pulse which transfers the content of the counting circuits to the storage and display units. The transfer pulse is generated automatically at the end of the count interval.

9.3 The print command circuit produces a positive pulse that instructs a digital printer to record the BCD information from the display circuits. The circuit comprises monostable A3U7B, A3U7A and transistor A3Q4.

10. COUNTING AND DISPLAY CIRCUITS

10.1 The counting and display circuits consist of nine decimal counters, memory circuits and decoders which drive numerical display tubes.

10.2 The 10^0 decimal counter comprises MECL III and MECL II flip-flops U19, U20, U21 and U49, which are contained on the main board. It counts the signal on the count line and when it reaches a count of 10, it produces a carry pulse which is counted by the 10^1 decimal counter. The 10^1 counter drives the 10^2 counter, etc., in a similar manner.

10.3 The BCD output of the counters is stored by the memory circuits. With a logic 0 at the transfer terminals, the count is transferred to the decoders.

11. POWER SUPPLY

11.1 The power supply provides +200 V, ± 15 V and +5 V. The instrument may be operated from a 115 V or 230 V a.c. source. Switch A2S2 provides the proper power transformer connection according to the source used.

11.2 The +200 V output is unregulated and is the supply voltage for the display tubes.

11.3 The +15 V output is regulated and is one of the supply voltages for the input circuit. A3Q26 is a series power transistor and A3U50 provides a constant reference voltage.

11.4 The +5 V output is the supply voltage for all of the micrologic. Q27 is the series regulator and is driven by the emitter follower A3Q12.

11.5 The −15 V output is regulated and is one of the supply voltages for the input circuit. A3Q11 and A3Q25 perform the same function as A3Q12 and Q27 in the +5 V supply. A3Q14 and A3Q13 form a differential amplifier to amplify the error voltage on the base of A3Q14.

SECTION 6

MAINTENANCE

1. INTRODUCTION

1.1 This section provides maintenance, calibration and service information for the SM 209 and SM 209F. Included are a table of recommended test equipment, input circuits adjustment, oscillator frequency adjustment and in-cabinet performance check which may be used to verify proper operation of the counter.

2. TEST EQUIPMENT

2.1 Recommended test equipment for troubleshooting, alignment and performance checking is listed in Table 6-1. Test instruments other than those listed may be used if their specifications equal or exceed the required characteristics.

Item	Requirement	Instrument or equivalent
1	50 kHz to 100 MHz, 5 mV to 5 V constant amplitude sinewave generator	Tektronix Type 191 Signal Generator or similar
2	10 to 500 MHz VHF oscillator	HP Model 3200B or similar
3	10 Hz to 10 MHz sinewave oscillator	HP Model 651A or similar
4	Oscilloscope having a d.c. to 50 MHz minimum bandwidth and sampling unit with a 1 GHz capability	HP Model 180A with plug-in units or similar
5	1 MHz frequency standard	HP Model 105A/B or similar
6	RF millivoltmeter	HP Model 411A or similar
7	True r.m.s. voltmeter	Ballantine 323 or similar

TABLE 6-1. RECOMMENDED TEST EQUIPMENT

3. INSTRUMENT COVER REMOVAL

3.1 To remove the top or bottom cover,unlock four quarter turn fasteners which secure cover to instrument. Then slide cover towards the top of instrument. To replace cover, reverse procedure.

WARNING

115/230 V a.c. and d.c. supply wires are exposed when either cover is removed. Disconnect the power lead while removing the covers.

4. CLEANING

4.1 The instrument should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation.

4.2 Thoroughly clean both the inside and outside of the instrument. Remove dust from inaccessible areas with low pressure compressed air or vacuum cleaner. Use alcohol applied with a cleaning brush to remove accumulations of dirt or grease from connector contacts and component terminals. Clean the exterior of the instrument and the front panel with a mild detergent mixed with water, applying the solution with a soft, lint-free cloth.

5. VISUAL INSPECTION

5.1 The instrument should be inspected occasionally for such defects as broken connections, loose, broken or frayed wiring, dirty or pitted switch and connector contacts and cracked or broken printed circuit boards. Often, before a total or partial failure occurs, a deteriorating component can be located due to obvious discoloration, cracking or warping. Care must be taken if heat-damaged parts are located. Over-heating is usually only a symptom of trouble. For this reason, it is essential to determine the actual cause of over-heating before the heat-damaged part is renewed, otherwise, the damage may be repeated.

6. REPAIR AND RENEWAL OF PARTS

6.1 Repair and replacement of electrical and mechanical parts must be accomplished with caution. Printed circuit component boards can become warped, cracked or burnt from excessive heat or mechanical stress. The following repair techniques are suggested to avoid inadvertant destruction or degradation of parts and assemblies.

6.2 Use ordinary 60/40 solder and a 35 to 40-watt pencil type soldering iron on the circuit board. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the circuit from the base material. To desolder components use a commercial "solder sipper".

Always replace a component with its exact duplicate as specified in the parts list.

7. IN-CABINET PERFORMANCE CHECK

The performance check outlined in the following paragraphs can be used to check the specifications of the Models SM 209 or SM 209F. It can be used:

(a) as part of incoming inspection check of instrument specifications,

(b) periodically, for instruments used in systems,

(c) as part of troubleshooting procedure,

(d) after any repairs or adjustments, before returning instrument to regular service.

If the instrument fails to meet the standards of the performance check at any time, refer to the appropriate adjustment procedure to correct the malfunction.

7.1 Check of Counting and Display Circuits

7.1.1 The following check is to verify the operation of the counting, decoding and display circuits:

(a) Set INPUT selector slide-switch on the front panel to CHANNEL A (Model SM 209 only).

(b) Connect a low frequency oscillator (Table 6-1) to the Channel A input.

(c) Set the STORAGE ON-OFF slide switch on the rear panel to OFF position.

(d) Turn DISPLAY TIME control on the front panel slightly clockwise out of POWER OFF.

(e) Press the 1 SEC TIME BASE push-button.

(f) While the counter's gate is open (as indicated by the GATE light) set the EXT CLOCK IN – 1 MHz CLOCK OUT slide switch on the rear panel to EXT CLOCK IN; the counter's gate remains open until the RESET push-button is pressed.

(g) Vary the frequency from 10 Hz to 10 MHz and check for correct counting for each digit separately.

7.2 BCD Outputs

7.2.1 This check is to verify correct operation and logic levels of the BCD output from the PRINTER connector on the rear panel. The characteristics of the BCD outputs are:

Logic: Positive true

Logic 1 Level: +5 V ±0.5 V, 2.5 kΩ source impedance
Logic 0 Level: +0.25 V at −1 mA.

(a) Set the controls and selectors as detailed in Para. 7.1, (a) to (f).

(b) Connect the oscilloscope (Table 6-1) to the pins of the PRINTER connector as given in Section 3, Para. 6.2 and verify the logic 0 and 1 levels.

Use: 10 Hz to check the 10^0 decade
100 Hz to check the 10^1 decade
1 kHz " " " 10^2 "
10 kHz " " " 10^3 "
100 kHz " " " 10^4 "
1 MHz " " " 10^5 "
10 MHz " " " 10^6 "
100 MHz " " " 10^7 and 10^8 decades.

7.3 BCD Output, Print Command

7.3.1 The characteristics of the print command are:

Positive pulse of 5 V, d.c. coupled. Source impedance is 1 kΩ when in the high state and 100 Ω when in the low state. Pulse duration is 1 ms (approx.). It occurs at end of the gate time:

(a) Set the clock selector slide-switch on the rear panel to 1 MHz CLOCK OUT.

(b) Turn the DISPLAY TIME control slightly clockwise, out of POWER OFF.

(c) Set INPUT selector to CHANNEL A (Model SM 209).

(d) Press one of the DISPLAY BLANKING pushbuttons.

(e) Connect the oscilloscope to pin 23 of the PRINTER connector. The oscilloscope should display the print command pulse after each closing of the counter's gate, as indicated by the GATE indicator.

7.4 PRINTER, Inhibit Input

7.4.1 The inhibit characteristics are:

A positive voltage of 3 V minimum and 50 V maximum inhibits the recycling circuitry of the counter.

(a) Set the controls, as detailed in Para. 7.3, (a) to (d).

(b) Connect a positive voltage to pin 22 of PRINTER connector, 3 V to 50 V, and check that the recycling circuitry of the counter is inhibited, as indicated by the GATE indicator.

7.5 Input Sensitivity, Channel A

7.5.1 To verify the input sensitivity of the Channel A, proceed as follows:

(a) Set INPUT selector slide-switch to "A".

(b) Set the SENSITIVITY control to maximum sensitivity (fully clockwise).

(c) Turn DISPLAY TIME control slightly clockwise out of POWER OFF.

(d) Connect a low frequency oscillator (Table 6-1) to the Channel A input.

(e) Vary the frequency of the oscillator from 10 Hz to 10 MHz, keeping output constant at 50 mV r.m.s. Counter should display correctly the frequencies in this range.

(f) Substitute the VHF oscillator (Table 6-1) for the low frequency oscillator.

(g) Vary the frequency of the VHF oscillator from 10 MHz to 220 MHz, keeping the output constant at 50 mV r.m.s. up to 120 MHz and increasing linearly to 100 mV r.m.s. at 220 MHz. The counter should display correctly, the frequencies in this range.

7.6 Input Sensitivity, Channel B

7.6.1 To verify the input sensitivity of Channel B, proceed as follows:

(a) Set INPUT selector slide switch to "B".

(b) Turn DISPLAY TIME control slightly clockwise, out of POWER OFF.

(c) Connect an oscillator (Table 6-1) to the Channel B input.

(d) Vary the frequency of the oscillator from 5 MHz to 512 MHz, keeping the output constant at 10 mV r.m.s. The counter should display correctly the frequencies in this range.

7.7 Input Sensitivity, EXT CLOCK IN (rear panel)

7.7.1 To check the input sensitivity of Channel C (EXT CLOCK IN), proceed as follows:

(a) Set INPUT selector slide-switch to "A".

(b) Turn DISPLAY TIME control slightly clockwise, out of POWER OFF.

(c) Connect a 10 MHz signal to Channel A. The exact frequency of the signal is of no importance.

(d) Connect a low frequency signal generator (Table 6-1) to the EXT CLOCK IN connector.

(e) Set the slide switch to EXT CLOCK IN.

(f) Vary the frequency of the low frequency oscillator from 1.2 MHz to 1 kHz, keeping the output constant at 250 mV r.m.s. The counter should display correctly, the ratio of the frequencies in this range. Please note, that the lower the frequency, the longer is the gate time.

8. ALIGNMENT PROCEDURE

The following paragraphs detail the alignment procedure used to calibrate the Model SM 209 or SM 209F for correct operation. The location of alignment controls and test points is shown in Section 8.

8.1 Input Circuit Adjustment, Channel A

(a) Connect a 150 MHz sinewave signal, 100 mV r.m.s., to the Channel A input.

(b) Adjust the front panel SENSITIVITY control for maximum sensitivity (fully clockwise).

(c) Connect an oscilloscope (Table 6-1) to the collector of Q25.

(d) Adjust trimpot R24 for maximum symmetry.

(e) Reduce the input signal amplitude until the waveform observed on the oscilloscope becomes erratic. Then increase the amplitude slightly and readjust the trimpot R24.

8.2 Input Circuit Adjustment, Channel B

8.2.1 The Channel B has no adjustment, except for the automatic gain control (a.g.c.) circuit which controls the input signal amplitude applied to the input amplifier.

(a) Connect a 30 MHz sinewave signal, 100 mV r.m.s. to the Channel B input.

(b) Connect an oscilloscope across resistor R93 (100 Ω).

(c) Adjust trimpot R40 for an amplitude of 600 mV peak-to-peak across R93.

(d) Increase input amplitude to 200 mV r.m.s. Check that the amplitude of 600 mV peak-to-peak is maintained across R93.

8.3 High-Speed-Decade Driver Adjustment

8.3.1 The high-speed-decade driver is formed by transistors Q28, Q29, Q30 and Q31, located on the main p.c. board. The output of emitter-follower Q31 is to be compatible with the MECL III input requirements, and should be normally high when no signal is applied to the driver. To adjust for correct operation proceed as follows:

(a) Connect an oscilloscope, d.c. coupled to the emitter of Q31.

(b) Turn, slowly, trimpot R65, starting from the fully anticlockwise position. The voltage at the starting point should be 4.2 V (approx).

(c) Just before the voltage begins to drop, stop the (clockwise) turning of the trimpot. Then return back to the anticlockwise direction for about 10 degrees.

NOTE: Slight readjustment may be necessary for correct operation at 512 MHz.

8.4 Clock Oscillator Calibration

(a) Remove the top cover from the SM 209

(b) Trigger the oscilloscope (Table 6.1, Item 4) from the 1 MHz Frequency Standard (Table 6.1, Item 5).

(c) Observe the 1 MHz signal from the 1 MHz CLOCK OUT socket on the rear panel, on the vertical axis of the oscilloscope.

(d) Adjust the trimmer in the top of the clock oscillator package, using a plastic screwdriver, until the pattern on the oscilloscope stops drifting. It is important that this adjustment is made after at least 24 hours of continuous operation of the SM 209.

SECTION 7

CIRCUITS, COMPONENT LAYOUTS AND TEST POINT WAVEFORMS

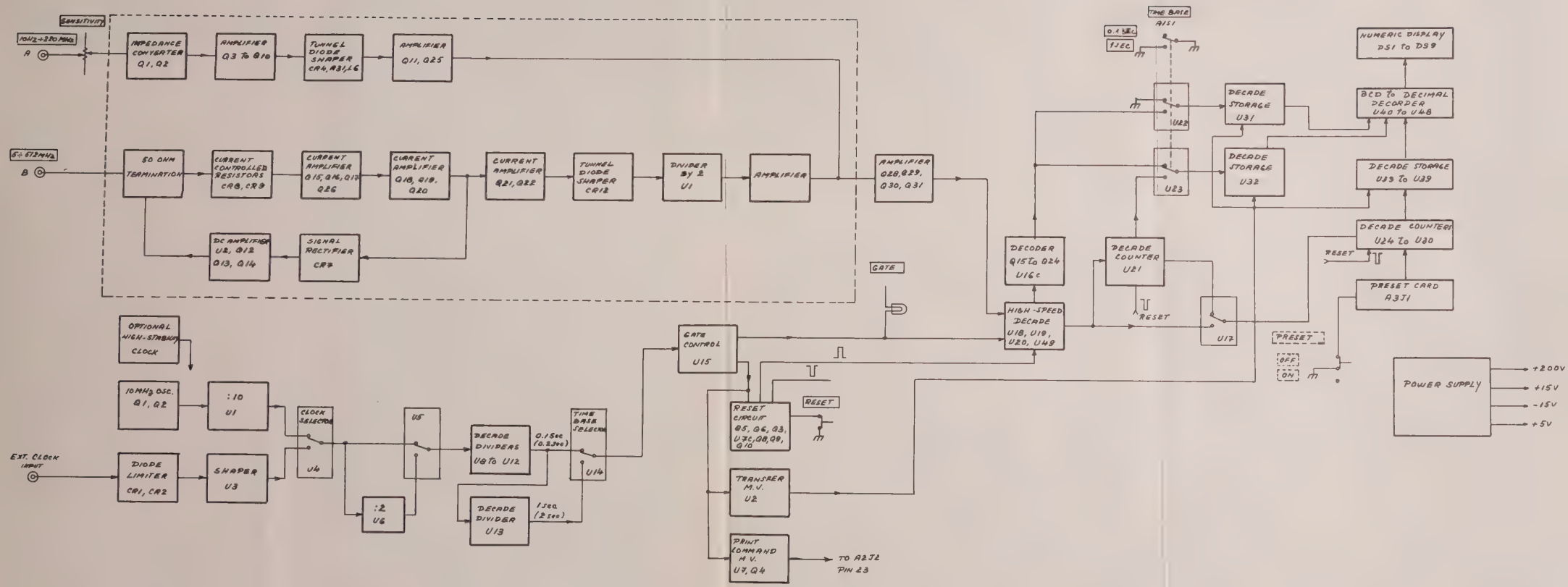


FIG. 1. FREQUENCY METER SM 209 - BLOCK SCHEMATIC

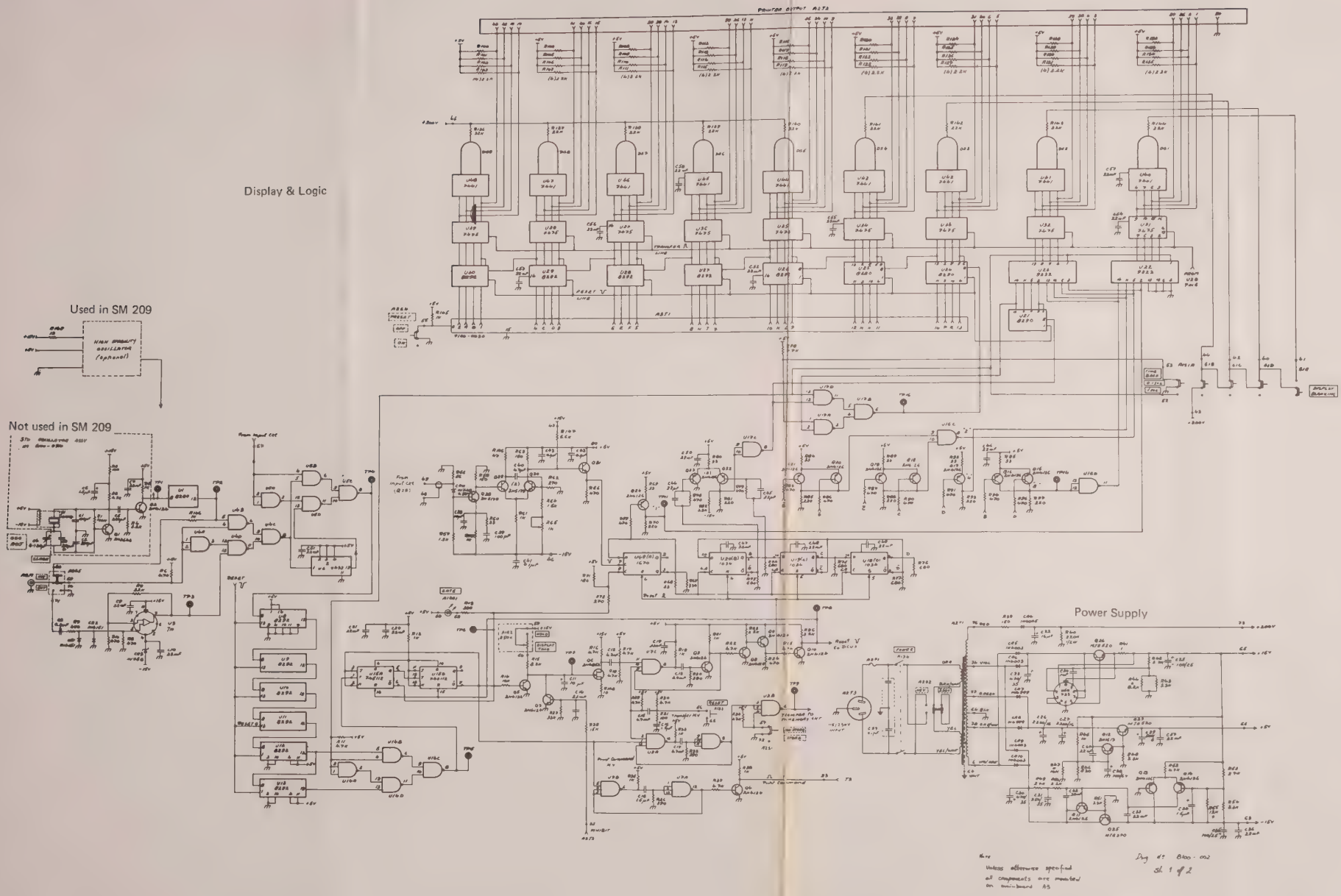
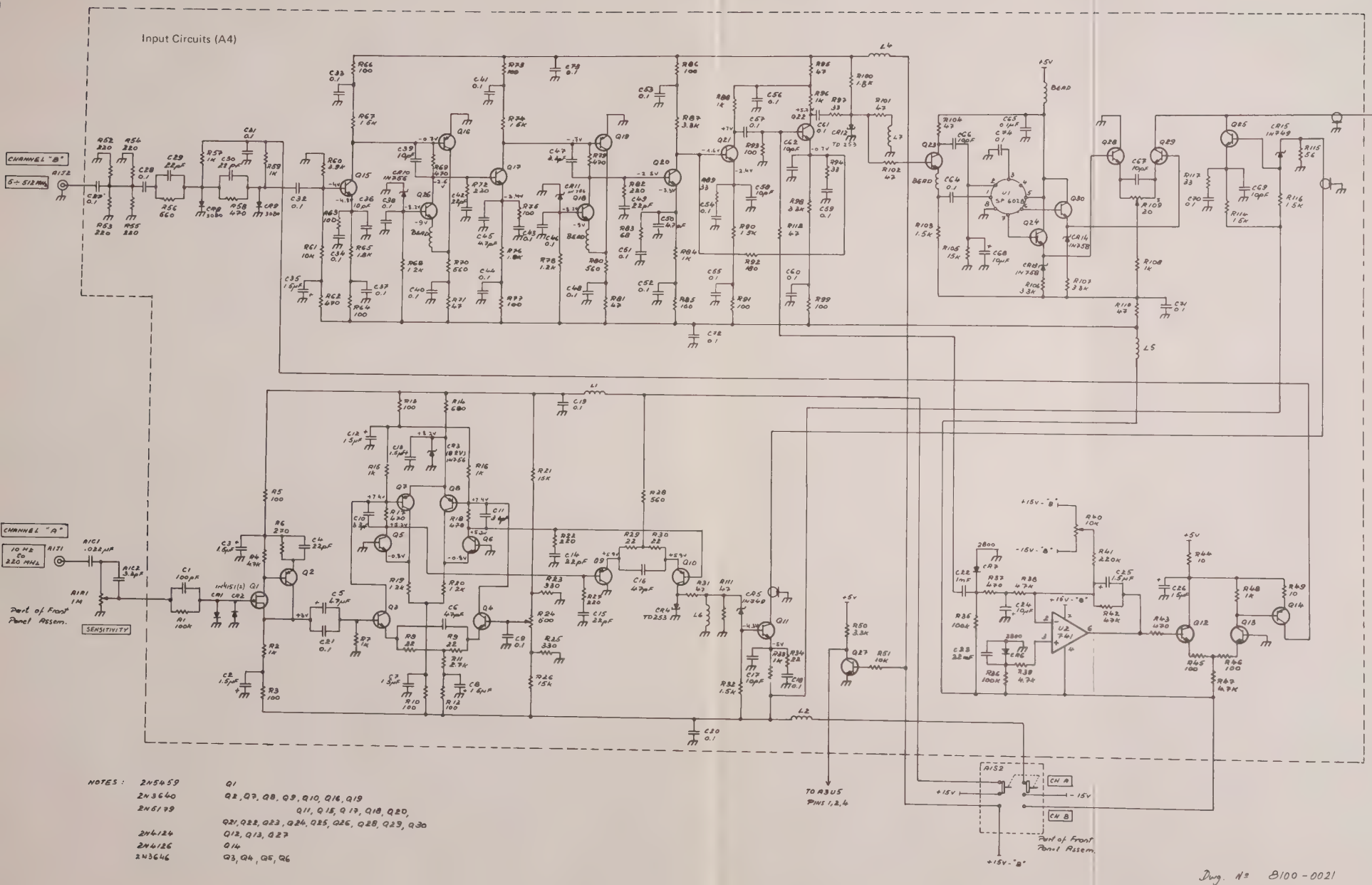


FIG. 2. FREQUENCY METER SM 209 - DISPLAY AND LOGIC CIRCUIT
POWER SUPPLY CIRCUIT



Dwg. No 8100-0021

FIG. 3. FREQUENCY METER SM 209 - INPUT CIRCUITS (A4)

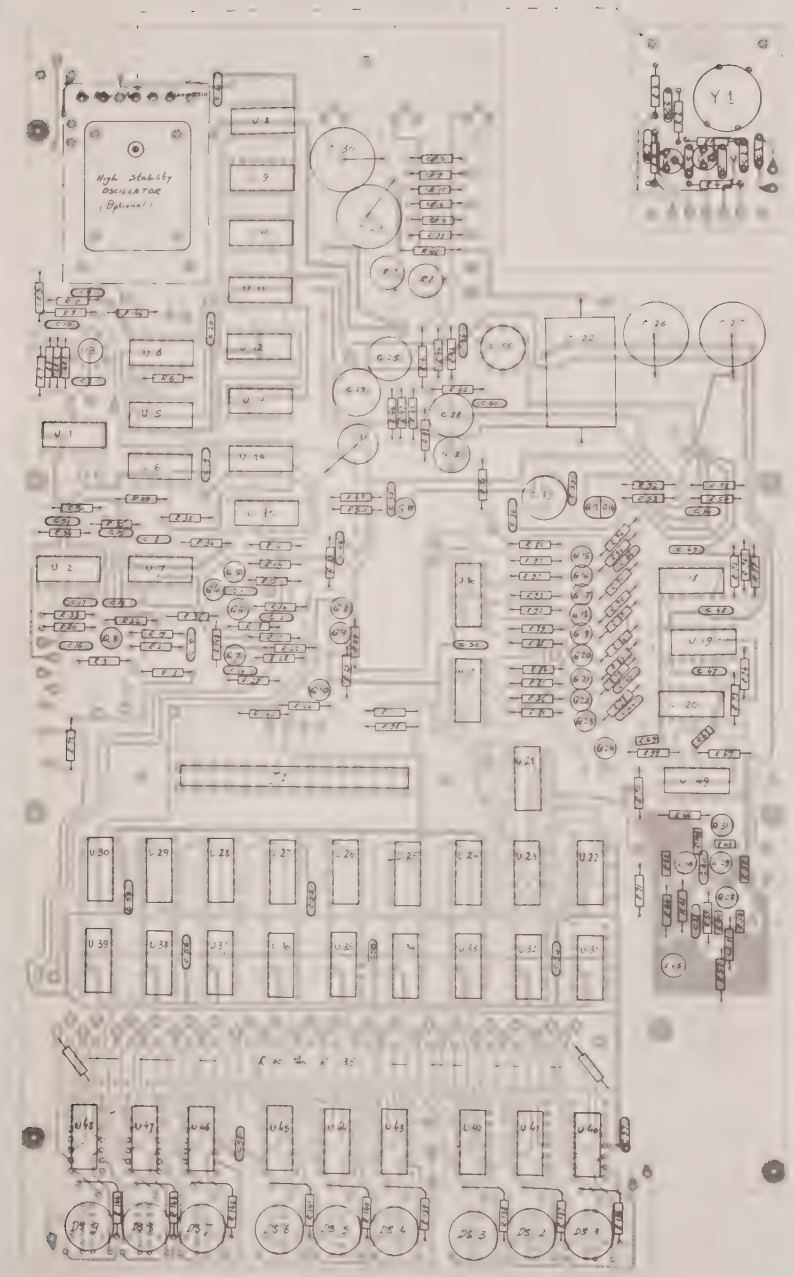
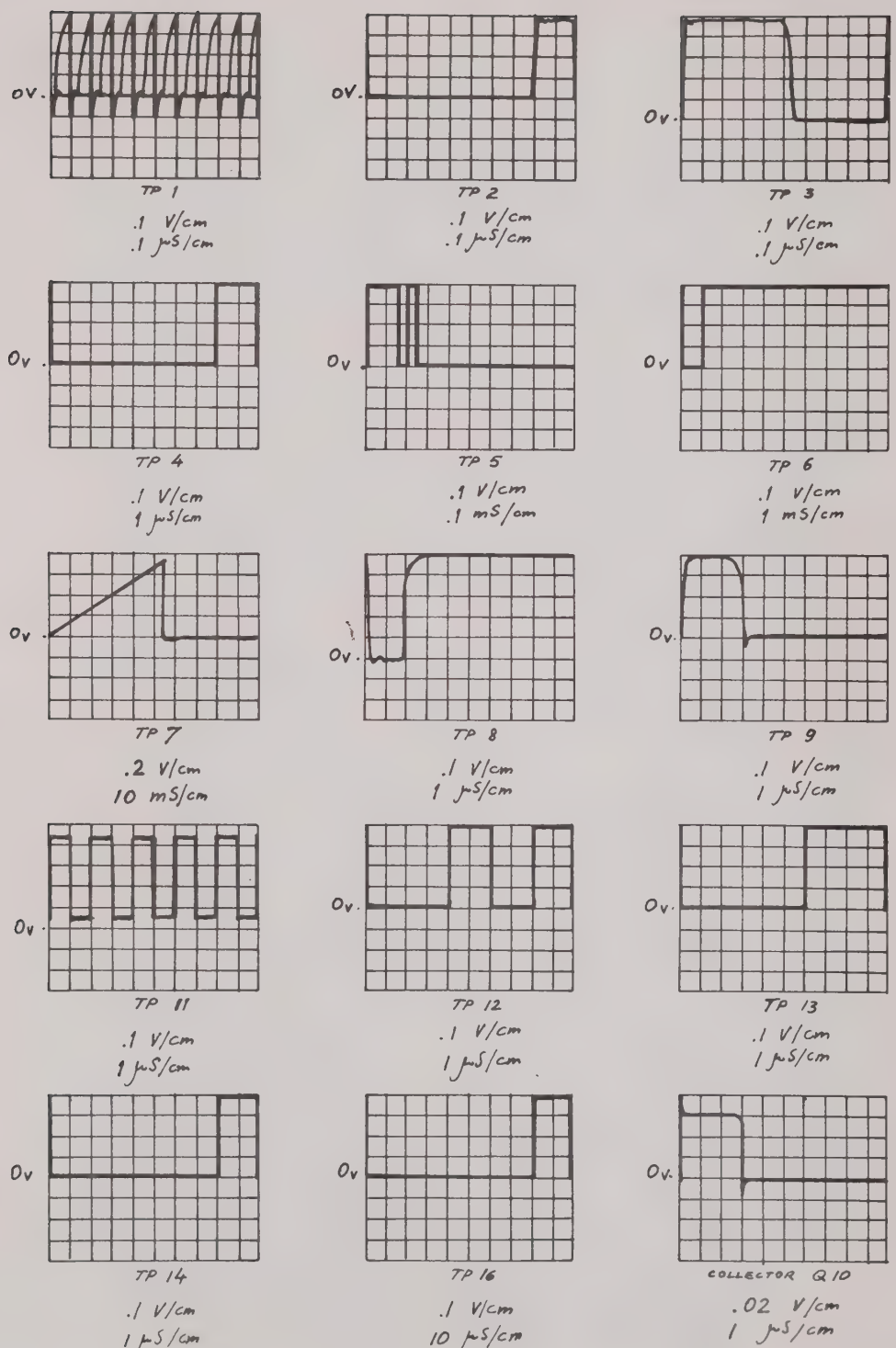


FIG. 4. MAIN P.C. BOARD (A3) - COMPONENT LAYOUT



All waveforms dc coupled through 10:1 divider probe.

Input A jack connected to 1 MHz clock output on rear panel.

Counter Controls :–

INPUT . . . . . A
TIME BASE . . . . . 1 Sec
DISPLAY TIME . . . . . min

FIG. 5. MAIN P.C. BOARD (A3) - TEST POINT WAVEFORMS

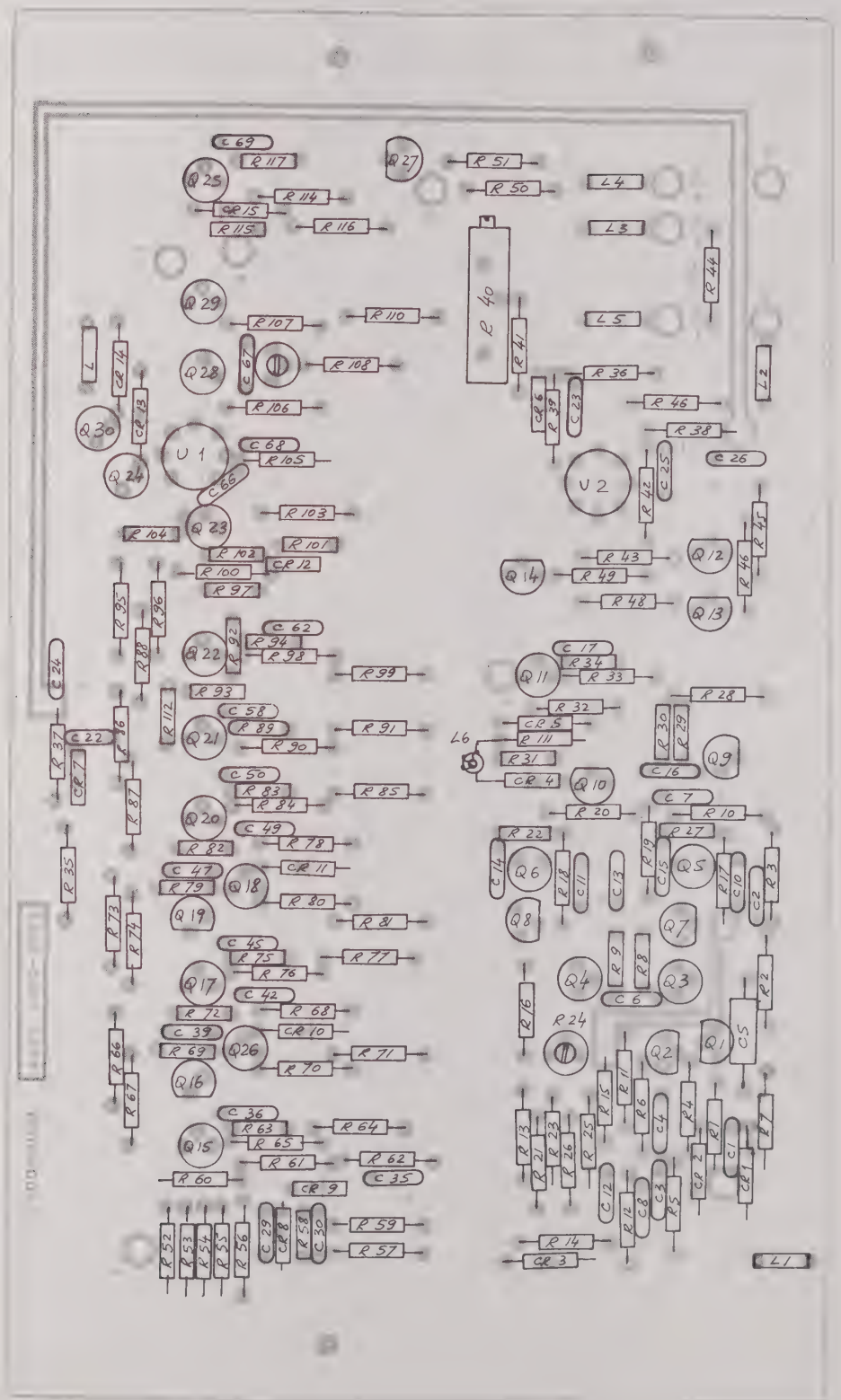
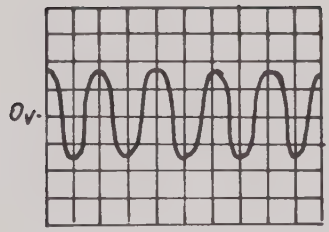
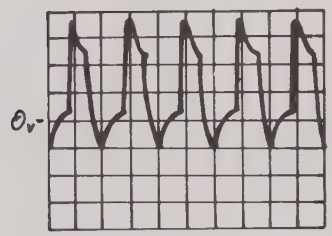


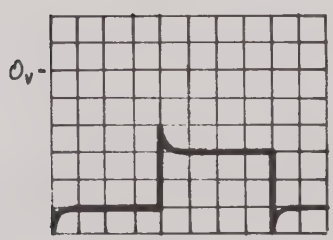
FIG. 6. INPUT CIRCUIT BOARD (A4) - COMPONENT LAYOUT



BASE Q 22
.002 V/cm
.02 μS/cm



ANODE CR 12
.02 V/cm
.02 μS/cm



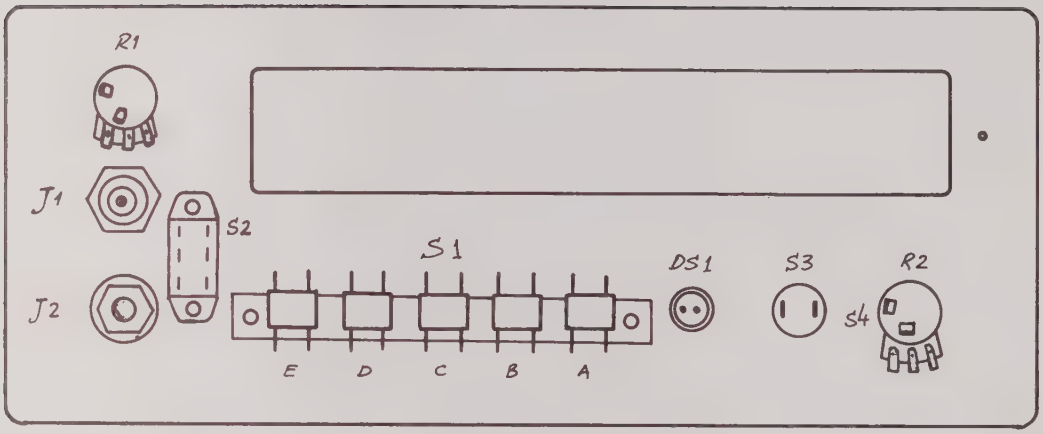
COLLECTOR Q29
.02 V/cm
.02 μS/cm

All waveforms dc coupled through 10:1 divider probe.

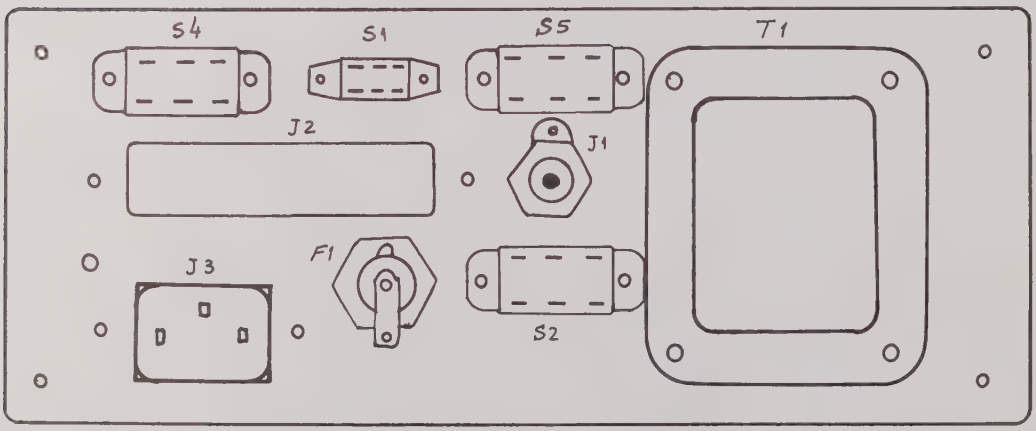
Input signal to jack B :-
FREQUENCY - - - - - 20 MHz
AMPLITUDE - - - - 100 mV ptp.

Counter Control/s :-
INPUT - - - B
TIME BASE - - - 1 Sec
DISPLAY TIME - - - min

FIG. 7. INPUT CIRCUIT BOARD (A4) - TEST POINT WAVEFORMS



Component locations, Front panel (Rear View).



Component locations, Rear panel (Rear View)

FIG. 8. FRONT AND REAR PANELS - COMPONENT LAYOUT

SECTION 8

PARTS LIST

1. ORDERING INFORMATION

1.1. The parts lists contained in this section are confined to electronic components. All information, relevant to a particular component, should be quoted when ordering. Address your order to ***Service Department, S.E. LABORATORIES (Engineering) LTD., NORTH FELTHAM TRADING ESTATE, FELTHAM, MIDDLESEX, ENGLAND. Tel. No. 01-890-1166.***

For Parts Lists, see overleaf:-

Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		DS1	LED RED		10000010	1
		J1	Connector BNC		30001000	1
		J2	Connector BNC (H.F.)		30010100	1
		R1	POT +SWC MLC 1MEG		02003020	1
		R2	POT +SWC MOAC 250K		02003010	1
		S1	SWC PIANO (5 Sections)		20000000	1
		S2	SWC SLIDE DPDT		20001000	1
		S3	SWC PUSH-BUT SPST		20002000	1

	Name	Issue Date	Title: Front Panel (A1)	
Drawn				
Check				
Appd.			Model No. SM 209	Dwg. No. 8100-0021
				Sheet 1 of 1

Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		F1	FUSE 0.3A SLO-BLO		1100/01/0	1
		J1	Connector BNC		30001000	1
		J2	Connector 50pin 57-40500		30000200	1
		J3	Receptacle AC		30002000	1
		S1	Swc SLIDE DPDT		20001000	1
		S2	Swc SLIDE 115-230 V		20001020	1
		S4	Swc SLIDE 115-230 V Modified		20001030	2
		S5	Swc SLIDE 115-230V Modified		2000/030	
		T1	Transformer ASSY		25000003	1
		XF1	Fuse Holder		1100001/0	1

	Name	Issue Date
Drawn		
Check		
Appd.		

Title: REAR PANEL (A2)

Model No. SM 209

Dwg. No. 8100-0021

Sheet 1 of 1

Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		R1	100K RFC ¼W 5%	V	01004000	1
		R2	4.7K " " "	V	01002080	14
		R3	100 " " "	V	01001000	2
		R4	3.3K " " "	V	01002060	6
		R5	1K " " "	V	01002000	12
		R6	4.7K " " "	V	01002080	
		R7	470 " " "	V	01001080	15
		R8	470 " " "	V	01001080	
		R9	22K " " "	V	01003040	10
		R10	470 " " "	V	01001080	
		R11	4.7K " " "	V	01002080	
		R12	1K " " "	V	01002000	
		R13	330 " " "	V	01001060	2
		R14	10K " " "	V	01003000	2
		R15	8.2K " " "	V	01002110	2
		R16	4.7K " " "	V	01002080	
		R17	4.7K " " "	V	01002080	
		R18	4.7K " " "	V	01002080	
		R19	1K " " "	V	01002000	
		R20	390 " " "	V	01001070	3
		R21	1K " " "	V	01002000	
		R22	4.7K " " "	V	01002080	
		R23	2.2K " " "	V	01002040	39
		R24	470 " " "	V	01001080	
		R25	4.7K " " "	V	01002080	
		R26	2.2K " " "	V	01002040	
		R27	33K " " "	V	01003060	1
		R28	15K " " "	V	01003020	1
		R29	4.7K " " "	V	01002080	
		R30	4.7K " " "	V	01002080	
		R31	100 " " "	V	01001000	
		R32	1K " " "	V	01002000	
		R33	390 " " "	V	01001070	

	Name	Issue Date
Drawn		
Check		
Appd.		

Title: Main P.C. Board (A3) and Input CKTS (A4)

Model No. SM 209 Dwg. No. 8100-0021

Sheet 1 of 9

Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		R34	4.7K RFC ¼w 5%	✓	0100208 0	
		R35	1K " " "	✓	0100100 0	
		R36	390 " " "	✓	0100107 0	
		R37	4.7K " " "	✓	0100208 0	
		R38	1K " " "	✓	0100200 0	
		R39	150 " " "	✓	0100102 0	1
		R40	220K " ½w 5%	✓	0101002 0	1
		R41	1Ω " " "	✓	0101000 0	1
		R42	2.7K " ¼w "	✓	0100205 0	3
		R43	3.3K " " "	✓	0100206 0	
		R44	8.2K " " "	✓	0100211 0	
		R45	1K " " "	✓	0100200 0	
		R46	820 " " "	✓	0100111 0	1
		R47	10K " " "	✓	0100300 0	
		R48	3.3K " " "	✓	0100206 0	
		R49	2.7K " " "	✓	0100205 0	
		R50	2.2K " " "	✓	0100204 0	
		R51	3.3K " " "	✓	0100206 0	
		R52	4.7K " " "	✓	0100208 0	
		R53	2.7K " " "	✓	0100205 0	
		R54	3.3K " " "	✓	0100206 0	
		R55	12K " " "	✓	0100301 0	1
		R56	56 " ⅛w "	✓	0102009 0	1
		R57	1.5K " ¼w "	✓	0100202 0	2
		R58	150 " ⅛w "	✓	0102103 0	2
		R59	1K " ¼w "	✓	0100200 0	
		R60	33 " ⅛w "	✓	0102006 0	3
		R61	1K " ¼w "	✓	0100200 0	
		R62	270 " ⅛w "	✓	0102105 0	1
		R63	150 " ⅛w "	✓	0102103 0	
		R64	1.5K " ¼w "	✓	0100202 0	
		R65	1K Pot. 3329H-1-102 Bourns	✓	0200151 0	1
		R66	470 RFC ¼w 5%	✓	0100108 0	

	Name	Issue Date	Title: Main P.C. Board	
Drawn				
Check				
Appd.			Model No. SM 209	Dwg. No.
				Sheet 2 of 9

Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		R67	330 RFC 1/4W 5%	✓	0100010600	
		R68	33 " 1/8W "	✓	0102000600	
		R69	33 " 1/8W 5%	✓	0102006600	
		R70	220 " 1/4W "	✓	0100104040	6
		R71	180 " " "	✓	0100103040	1
		R72	270 " " "	✓	0100105040	1
		R73	680 " " "	✓	0100111000	5
		R74	680 " " "	✓	0100111000	
		R75	680 " " "	✓	0100111000	
		R76	680 " " "	✓	0100111000	
		R77	680 " " "	✓	0100111000	
		R78	470 " " "	✓	0100108040	
		R79	470 " " "	✓	0100108040	
		R80	33 " " "	✓	0100000600	5
		R81	220 " " "	✓	0100104040	
		R82	3.3K " " "	✓	0100206040	
		R83	470 " " "	✓	0100108040	
		R84	33 " " "	✓	0100000600	
		R85	220 " " "	✓	0100104040	
		R86	470 " " "	✓	0100108040	
		R87	470 " " "	✓	0100108040	
		R88	220 " " "	✓	0100104040	
		R89	33 " " "	✓	0100000600	
		R90	470 " " "	✓	0100108040	
		R91	470 " " "	✓	0100108040	
		R92	33 " " "	✓	0100000600	
		R93	220 " " "	✓	0100104040	
		R94	470 " " "	✓	0100108040	
		R95	33 " " "	✓	0100000600	
		R96	470 " " "	✓	0100108040	
		R97	220 " " "	✓	0100104040	
		R98	4.7K " " "	✓	0100208040	
		R99	470 " " "	✓	0100108040	

	Name	Issue Date	Title: Main P.C. Board	
Drawn				
Check				
Appd.			Model No. SM 209	Dwg. No.
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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		R100-R135	2.2K RFC ¼W 5% (36 units)	V	0100204 0	
		R136-R144	22K " " " (9 units)	V	0100304 0	
		R145	1K " " "		0100200 0	
		R146	47 " 1/8W "			1
		R147	5.6K " 1/4W "			1
		R148	10 " " "			1
		R149	12 " 1/2W "			1
		R150	1K " 1/4W		0100200 0	
		C1	100pf CMD 5%	✓	1500405 0	1
		C2	390pf CMD 5%	✓	1500410 0	1
		C3	* 24pf typical CMD 5%	✓	1500400 0	1
		C4	TRIM CAP. 7-25pf DV11PR25B	✓	1500501 0	1
		C5	220pf CCD	✓	1500012 0	1
		C6	1.5µF/35V CCT	✓	1500100 0	4
		C7	22m/16V CCD	✓	1500029 0	25
		C8	0.1µF/50V	✓	1500600 0	1
		C9	22m/16V CCD	✓	1500029 0	
		C10	22m/16V "	✓	1500029 0	
		C11	10µF/35V CCT	✓	1500100 0	1
		C12	4.7m/500V CCD	✓	1500024 0	4
		C13	4.7m/500V CCD	✓	1500024 0	
		C14	22m/16V CCD	✓	1500029 0	
		C15	4.7m/500V CCD	✓	1500024 0	
		C16	1.5µ/35V CCT	✓	1500100 0	
		C17	4.7m/500V CCD	✓	1500024 0	
		C18	1.5µF/35V CCT	✓	1500100 0	
		C19	22m/16V CCD	✓	1500029 0	
		C20	22m/16V "	✓	1500029 0	

	Name	Issue Date	Title: Main P.C. Board	
Drawn				
Check				
Appd.			Model No. SM 209	Dwg. No.
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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		C 21	22n/16V CCD	✓	1500029 0	
		C 22	16µf/400V CEA	✓	1500 2010	1
		C 23	470µf/35V CEA	✓	1500 2110	2
		C 24	1n/1000V CCD	✓	1500 0200	1
		C 25	100µf/16V CEA	✓	1500 2030	3
		C 26	2200µf/16V CEA	✓	1500 2100	2
		C 27	2200µf/16V CEA	✓	1500 2100	
		C 28	100µf/16V CEA	✓	1500 2030	
		C 29	470µf/6V CEA	✓	1500 2060	1
		C 30	470µf/35V	✓	1500 2110	
		C 31	220µf/35V CEA	✓	1500 2050	1
		C 32	22n/16V CCD	✓	1500 0290	
		C 33	22n/16V CCD	✓	1500 0290	
		C 34	1.5µf/35V CCT	✓	1500 1000	
		C 35	100µf/16V CEA	✓	1500 2030	
		C 36	22n/16V CCD	✓	1500 0290	
		C 37	22n/16V CCD	✓	1500 0290	
		C 38	10pf/500V CCD	✓	1500 0050	1
		C 39	100pF CCD	✓	1500 0100	1
		C 40	4.7pF CCD	✓	1500 0030	1
		C 41	0.1µf/50V CAP. CHIP	✓	1500 7000	3
		C 42	0.1µf/50V CAP. CHIP	✓	1500 7000	
		C 43	0.1µf/50V CAP CHIP	✓	1500 7000	
		C 44	22pf/500V CCD	✓	1500 0070	2
		C 45	22pf/500V "	✓	1500 0070	
		C 46	22n/16V "	✓	1500 0290	
		C 47	22n/16V CCD	✓	1500 0290	
		C 48	22n/16V "	✓	1500 0290	
		C 49	22n/16V "	✓	1500 0290	
		C 50	22n/16V CCD	✓	1500 0290	
		C 51	22n/16V CCD	✓	1500 0290	
		C 52	22n/16V "	✓	1500 0290	
		C 53	22n/16V "	✓	1500 0290	

	Name	Issue Date
Drawn		
Check		
Appd.		

Title: Main P.C. Board

Model No. SM 209 | Dwg. No.

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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		C54	22m/16V CCD	✓	1500029 0	
		C55	22m/16V "	✓	1500029 0	
		C56	22m/16V "	✓	1500029 0	
		C57	22m/16V "	✓	1500029 0	
		C58	22m/16V "	✓	1500029 0	
		C59	CAP. SUPRS 0.1+2.500PF F1740-410-391	✓	1501 0000	1
		C60	22m/16V CCD		1500029 0	
		Q1	2 N3646 Trans. N.P.N.	✓	0400 003 0	1
		Q2	2N4124 " "	✓	0400 003 0	8
		Q3	2N4124 " "	✓	0400 003 0	
		Q4	2N4124 " "	✓	0400 003 0	
		Q5	2N4124 " "	✓	0400 003 0	
		Q6	2N4852 " UNIJ		0400 006 0	1
		Q7	2N4124 " N.P.N.	✓	0400 003 0	
		Q8	2N4124 " "	✓	0400 003 0	
		Q9	2N4124 " "	✓	0400 003 0	
		Q10	2N4124 " "	✓	0400 003 0	
		Q11	2N4126 " P.N.P	✓	0400 004 0	13
		Q12	2N1613 " NPN	✓	0400 0000	1
		Q13	2N4126 " PNP	✓	0400 0040	
		Q14	2N4126 " "	✓	0400 0040	
		Q15	2N4126 " "	✓	0400 0040	
		Q16	2N4126 " "	✓	0400 0040	
		Q17	2N4126 " "	✓	0400 0040	
		Q18	2N4126 " "	✓	0400 0040	

	Name	Issue Date	Title:
Drawn			Main P.C. Board
Check			
Appd.			Model No. SM 209 Dwg. No.
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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		Q 19	2N 4126 Trans. P.N.P	✓	0400004 0	
		Q 20	2N 4126 " "	✓	0400004 0	
		Q 21	2N 4126 " "	✓	0400004 0	
		Q 22	2N 4126 " "	✓	0400004 0	
		Q 23	2N 4126 " "	✓	0400004 0	
		Q 24	2N 4126 " "	✓	0400004 0	
		Q 25	MJE 370 " "	✓	0400100 0	1
		Q 26	MJE 520 " N.P.N	✓	0400101 0	2
		Q 27	MJE 520 " "	✓	0400101 0	
		Q 28	2N 5179 " "	✓	0400007 0	4
		Q 29	2N 5179 " "	✓	0400007 0	
		Q 30	2N 5179 " "	✓	0400007 0	
		Q 31	2N 5179 " "	✓	0400007 0	
		CR 1	1N 4151 DIO Silicon	✓	0300040 0	2
		CR 2	1N 4151 DIO "	✓	0300040	
		CR 3	1N 758 DIO Zener 10V	✓	0300204 0	1
		CR 4	1N4005 DIO Rectifier	✓	0300301 0	1
		CR 5	1N4003 " "	✓	0300300 0	4
		CR 6	1N4003 " "	✓	0300300 0	
		CR 7	1N4999 " "	✓	0300302 0	2
		CR 8	1N4999 " "	✓	0300302 0	
		CR 9	1N4003 " "	✓	0300300 0	
		CR 10	1N4003 " "	✓	0300300 0	
		CR 11	1N749 " Zener 4.3V	✓	0300209 0	1
					0300	

	Name	Issue Date	Title: Main P.C. Board	
Drawn				
Check				
Appd.			Model No. SM 209	Dwg. No.
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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		U1	N8280A Dec. Counter	✓	0500 1000	2
		U2	7410 3 in NAND	✓	0500 0030	2
		U3	710 Schmitt Trigger	✓	0500 5000	1
		U4	7400 Quad Nand	✓	0500 0010	4
		U5	7400 " "	✓	0500 0010	
		U6	7473 Dual JK	✓	0500 0100	1
		U7	7410 Triple Nand	✓	0500 0030	
		U8	N8292A Dec. Counter	✓	0500 1000	11
		U9	N8292A " "	✓	0500 1000	
		U10	N8292A " "	✓	0500 1000	
		U11	N8292A " "	✓	0500 1000	
		U12	N8292A " "	✓	0500 1000	
		U13	N8292A " "	✓	0500 1000	
		U14	7400 Quad Nand	✓	0500 0010	
		U15	74S112 Dual JK	✓	0500 2020	1
		U16	7400 Quad Nand	✓	0500 0010	
		U17	74S00 " "	✓	0500 2000	1
		U18	MC1034 Mecl F.F	✓	0500 4010	3
		U19	MC1034 " "	✓	0500 4010	
		U20	MC1034 " "	✓	0500 4010	
		U21	N8290A Dec. Counter	✓	0500 1030	2
		U22	9322	✓	0500 1020	2
		U23	9322	✓	0500 1020	
		U24	N8290A Dec. Counter	✓	0500 1030	
		U25	N8280A " "	✓	0500 1000	
		U26	N8292A " "	✓	0500 1000	
		U27	N8292A " "	✓	0500 1000	
		U28	N8292A " "	✓	0500 1000	
		U29	N8292A " "	✓	0500 1000	
		U30	N8292A " "	✓	0500 1000	
		U31	7475 Quad Latch	✓	0500 0120	9
		U32	7475 " "	✓	0500 0120	
		U33	7475 " "	✓	0500 0120	

	Name	Issue Date
Drawn		
Check		
Appd.		

Title: Main P.C. Board

Model No. SM 209 | Dwg. No.

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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		U34	7475 Quad Latch	J	0500 0120	
		U35	7475 " "	J	0500 0120	
		U36	7475 " "	J	0500 0120	
		U37	7475 " "	J	0500 0120	
		U38	7475 " "	J	0500 0120	
		U39	7475 " "	J	0500 0120	
		U40	7441 Decoder	J	0500 0070	9
		U41	7441 "	J	0500 0070	
		U42	7441 "	J	0500 0070	
		U43	7441 "	J	0500 0070	
		U44	7441 "	J	0500 0070	
		U45	7441 "	J	0500 0070	
		U46	7441 "	J	0500 0070	
		U47	7441 "	J	0500 0070	
		U48	7441 "	J	0500 0070	
		U49	MC1670 MECL III F.F	J	0500 4040	1
		U50	723 Regulator	✓	0500 5010	1
			DUAL CLIP 256-DT WAREFIELD		3800 0000	1
		DS1-DS9	TUBE		1200 0000	9
		J-1	Conector 30 PIN		3000 0000	1
			OVEN CRS MSTI-2		1900 0000	1
		Y1	10MHz TO-5 CRS		0800 0000	1
			PIN MALE 60804/1		9300 0000	68
			TURRE TERMINALS TYPE I 39 203		9500 2000	18
			P.C. BOARD		7100 0210	1
			Main P.C. Board		7100 0012	1
			SPACER 3/8 Hex.			4
			PEN HEAD SCREW NC-4 x 1/4			8
			SPRING WASHER NC-4		9200 1020	8

	Name	Issue Date	Title: Main P.C. Board	
Drawn				
Check				
Appd.			Model No. SM 209	Dwg. No.
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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		R1	100K RFC ¼W 5%		0100400 0	3
		R2	1K " " "		0100200 0	12
		R3	100 " " "		0100100 0	15
		R4	4.7K " " "		0100208 0	4
		R5	100 " " "		0100100 0	
		R6	270 " " "		0100105 0	1
		R7	1K " " "		0100200 0	
		R8	22 " ⅛W "		0102004 0	5
		R9	22 " ⅛W "		0102004 0	
		R10	100 " ¼W "		0100100 0	
		R11	2.7K " " "		0100205 0	1
		R12	100 " " "		0100100 0	
		R13	100 " " "		0100100 0	
		R14	680 " " "		0100110 0	1
		R15	1K " " "		0100200 0	
		R16	1K " " "		0100200 0	
		R17	470 " " "		0100108 0	5
		R18	470 " " "		0100108 0	
		R19	1.2K " " "		0100201 0	4
		R20	1.2K " " "		0100201 0	
		R21	15K " " "		0100302 0	3
		R22	220 " ⅛W "		0102104 0	4
		R23	330 " ¼W "		0100106 0	2
		R24	Trimer 500Ω 3329H "		0200150 0	1
		R25	330 RFC ¼W "		0100106 0	
		R26	15K " " "		0100302 0	
		R27	220 " ⅛W "		0102104 0	
		R28	560 " ¼W "		0100109 0	4
		R29	22 " ⅛W "		0102004 0	
		R30	22 " ⅛W "		0102004 0	
		R31	47 " ⅛W "		0102008 0	5
		R32	1.5K " ¼W "		0100201 0	7
		R33	1K " ¼W "		0100200 0	

	Name	Issue Date
Drawn		
Check		
Appd.		

Title: Input circuit A4

Model No. SM209 | Dwg. No.

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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		R34	22 RFc 1/8w 5%		0102004 0	
		R35	100K " 1/4w "		0100400 0	
		R36	100K " " "		0100400 0	
		R37	470 " " "		0100108 0	
		R38	4.7K " " "		0100208 0	
		R39	4.7K " " "		0100208 0	
		R40	10K Trimer 3007P		0200060 0	1
		R41	220K RFc 1/4w 5%		0100404 0	1
		R42	47K " " "		0100308 0	1
		R43	470 " " "		0100108 0	
		R44	10 " " "		0100000 0	2
		R45	100 " " "		0100100 0	
		R46	100 " " "		0100100 0	
		R47	4.7K " " "		0100208 0	
		R48	1K " " "		0100200 0	
		R49	10 " " "		0100000 0	
		R50	3.3K " " "		0100206 0	5
		R51	10K " " "		0100300 0	2
		R52	220 " " "		0100104 0	4
		R53	220 " " "		0100104 0	
		R54	220 " " "		0100104 0	
		R55	220 " " "		0100104 0	
		R56	560 " " "		0100109 0	
		R57	1K " " "		0100200 0	
		R58	470 " 1/8w "		0102108 0	3
		R59	1K " 1/4w "		0100200 0	
		R60	3.9K " " "		0100207 0	1
		R61	10K " " "		0100300 0	
		R62	470 " " "		0100108 0	
		R63	100 " 1/8w "		0102100 0	3
		R64	100 " 1/4w "		0100100 0	
		R65	1.8K " " "		0100203 0	3
		R66	100 " " "		0100100 0	

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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		R67	1.5K RFC 1/4W 5%	✓	0100202 0	
		R68	1.2K " " "		0100201 0	
		R69	470 " 1/8W "		0102108 0	
		R70	560 " 1/4W "		0100109 0	
		R71	47 " " "		0100008 0	5
		R72	220 " 1/8W "		0102104 0	
		R73	100 " 1/4W "		0100100 0	
		R74	1.5K " " "	✓	0100202 0	
		R75	100 " 1/8W "	✓	0102100 0	
		R76	1.8K " 1/4W "	✓	0100203 0	
		R77	100 " " "		0100100 0	
		R78	1.2K " " "		0100201 0	
		R79	470 " 1/8W "		0102108 0	
		R80	560 " 1/4W "		0100109 0	
		R81	47 " " "		0100008 0	
		R82	220 " 1/8W "		0102104 0	
		R83	68 " 1/8W "	✓	0102010 0	1
		R84	1K " 1/4W "		0100200 0	
		R85	100 " " "		0100100 0	
		R86	100 " " "		0100100 0	
		R87	3.3K " " "		0100206 0	
		R88	1K " " "		0100200 0	
		R89	33 " 1/8W "	✓	0102006 0	4
		R90	1.5K " 1/4W "	✓	0100202 0	
		R91	100 " " "		0100100 0	
		R92	180 " 1/8W "		0102108 0	1
		R93	100 " 1/8W "		0102100 0	
		R94	33 " 1/8W "	✓	0102006 0	
		R95	47 " 1/4W "		0100008 0	
		R96	1K " " "		0100200 0	
		R97	33 " 1/8W "	✓	0102006 0	
		R98	3.3K " 1/4W "	✓	0100206 0	
		R99	100 " 1/4W "		0100100 0	

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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		R100	1.8K RFC 1/4W 5%		0100203 0	
		R101	47 " 1/8W "		0102008 0	
		R102	47 " " "		0102008 0	
		R103	1.5K " 1/4W "		0100202 0	
		R104	47 " 1/8W "		0102008 0	
		R105	15K " 1/4W "		0100302 0	
		R106	3.3K " " "		0100206 0	
		R107	3.3K " " "		0100206 0	
		R108	1K " " "		0100200 0	
		R109	not used			
		R110	47 RFC 1/4W 5%		0100008 0	
		R111	47 " " "		0100008 0	
		R112	47 " 1/8W "		0102008 0	
		R113	not used			
		R114	1.5K RFC 1/4W 5%		0100202 0	
		R115	56 " 1/8W "		0102009 0	1
		R116	1.5K " 1/4W "		0100202 0	
		R117	33 " 1/8W "		0102006 0	

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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		C1	100P/1000V CCD	✓	1500010000	1
		C2	1.5μ/35V CCT	✓	10000	9
		C3	1.5μ/35V "	✓	10000	
		C4	22P/500V CCD	✓	00700	7
		C5	47μ/10V CEA	✓	20200	1
		C6	47P/500V CCD	✓	05000	2
		C7	1.5μ/35V CCT	✓	10000	
		C8	1.5μ/35V CCT	✓	10000	
		C9	0.1μ CAP. CHIP	✓	70000	36
		C10	3.3P/500V CCD	✓	00200	3
		C11	3.3P/500V "	✓	00200	
		C12	1.5μ/35V CCT	✓	10000	
		C13	1.5μ/35V CCT	✓	10000	
		C14	22P/500V CCD	✓	00700	
		C15	22P/500V "	✓	00700	
		C16	47P/500V "	✓	05000	
		C17	10P/500V "	✓	00500	8
		C18	0.1μ CAP. CHIP	✓	70000	
		C19	0.1μ -"- -"-	✓	70000	
		C20	0.1μ -"- -"-	✓	70000	
		C21	0.1μ -"- -"-	✓	70000	
		C22	1nf/1000V CCD	✓	02000	1
		C23	22m/16V "	✓	02900	1
		C24	10μ/35V CCT	✓	10100	2
		C25	1.5μ/35V CCT	✓	10000	
		C26	1.5μ/35V CCT	✓	10000	
		C27	0.1μ CAP. CHIP	✓	70000	
		C28	0.1μ " "	✓	70000	
		C29	22P/500V CCD	✓	00700	
		C30	22P/500V "	✓	00700	
		C31	0.1μ CAP. CHIP	✓	70000	
		C32	0.1μ -"- -"-	✓	70000	
		C33	0.1μ -"- -"-	✓	70000	

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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		C34	0.1μ CAP CHIP	✓	1500 7000	
		C35	1.5μ/35V CCT	✓	1000	
		C36	10P/500V CCD	✓	0050	
		C37	0.1μ CAP CHIP	✓	7000	
		C38	0.1μ -"- -"-	✓	7000	
		C39	10P/500V CCD	✓	0050	
		C40	0.1μ CAP CHIP	✓	7000	
		C41	0.1μ -"- -"-	✓	7000	
		C42	22P/500V CCD	✓	0070	
		C43	0.1μ CAP CHIP	✓	7000	
		C44	0.1μ -"- -"-	✓	7000	
		C45	4.7P/500V CCD	✓	0030	2
		C46	0.1μ CAP CHIP	✓	7000	
		C47	3.3P/500V CCD	✓	0020	
		C48	0.1μ CAP CHIP	✓	7000	
		C49	22P/500V CCD	✓	0070	
		C50	4.7p/500V -"-	✓	0030	
		C51	0.1μ CAP CHIP	✓	7000	
		C52	0.1μ -"- -"-	✓	7000	
		C53	0.1μ -"- -"-	✓	7000	
		C54	0.1μ -"- -"-	✓	7000	
		C55	0.1μ -"- -"-	✓	7000	
		C56	0.1μ -"- -"-	✓	7000	
		C57	0.1μ -"- -"-	✓	7000	
		C58	10P/500V CCD	✓	0050	
		C59	0.1μ CAP CHIP	✓	7000	
		C60	0.1μ -"- -"-	✓	7000	
		C61	0.1μ -"- -"-	✓	7000	
		C62	10P/500V CCD	✓	0050	
		C63	Not used	✓		
		C64	0.1μ -"- -"-	✓	7000	
		C65	0.1μ -"- -"-	✓	7000	
		C66	10P/500V	✓	0050	

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Rev	Item No.	Dwg. Ref.	Description/Title	Dwg. size	Part/Dwg. No.	Qty.
		C67	10P/500V CCD	✓	1500005 0	
		C68	10µ/35V CCT	✓	1500101 0	
		C69	10P/500V CCD	✓	1500005 0	
		C70	0.1µ CAP CHIP	✓	1500700 0	
		C71	0.1µ CAP CHIP	✓	1500700 0	
		C72	0.1µ CAP CHIP	✓	1500700 0	
		C73	0.1µ -"- -"-	✓	1500700 0	
		C74	0.1µ " "		1500700 0	
		Q1	2N5459	~	0400080	1
		Q2	2N3640	✓	0400010	7
		Q3	(2N 5179) 2N3646	✓	0400020	4
		Q4	(2N 5179) 2N 3646	✓	0400020	
		Q5	(2N 5179) 2N 3646	✓	0400020	
		Q6	(2N 5179) 2N 3646	✓	0400020	
		Q7	2N 3640	✓	0400010	
		Q8	2N3640	✓	0400010	
		Q9	2N3640	✓	0400010	
		Q10	2N3640	✓	0400010	
		Q11	2N 5179	✓	0400070	14
		Q12	2N4124	✓	0400030	3
		Q13	2N4124	✓	0400030	
		Q14	2N4126	✓	0400040	1
		Q15	2N5179	✓	0400070	
		Q16	2N3640	✓	0400010	
		Q17	2N5179	✓	0400070	
		Q18	2N5179	✓	0400070	
		Q19	2N3640	✓	0400010	
		Q20	2N 5179	✓	0400070	

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		Q21	2N 5179	✓	04000070	
		Q22	2N 5179	✓	04000070	
		Q23	2N 5179	✓	04000070	
		Q24	2N 5179	✓	04000070	
		Q25	2N 5179	✓	04000070	
		Q26	2N 5179	✓	04000070	
		Q27	2N4124	✓	04000030	
		Q28	2N5179		04000070	
		Q29	2N5179		04000070	
		Q30	2N5179		04000070	
		CR1	1N4151	✓	03000040	2
		CR2	1N4151	✓	03000040	
		CR3	1N756	✓	03000270	3
		CR4	TD253	✓	03000000	2
		CR5	1N749	✓	03000290	2
		CR6	2800	✓	03000100	2
		CR7	2800	✓	03000100	
		CR8	3080	✓	03000101	2
		CR9	3080	✓	03000101	
		CR10	1N756	✓	03000270	
		CR11	1N756	✓	03000270	
		CR12	TD253	✓	03000000	
		CR13	1N758 } matched	✓	03000240	2
		CR14	1N758	✓	03000240	
		CR15	1N749	✓	03000290	
		U1	SP602B			1
		U2	741			1
		L1	Bead		42000000	5
		L2	-"-		42000000	
		L3	-"-		42000000	
		L4	-"-		42000000	
		L5	-"-		42000000	
		L6	coil		07000001	1
			Beads Ceramag 7D		42000010	8

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SE Laboratories (Engineering) Limited. North Feltham Trading Estate, Feltham, Middlesex.
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